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A NOVEL ARRANGEMENT OF COG WHEELS.

Our engraving shows a train of wheels in which the driving shaft is formed with a crank handle, and the last driven shaft with a pointer. While the handle is making one complete revolution, the pointer is making one revolution in one direction and nearly four in the opposite; also the velocity of the pointer varies in each instance, the time consumed by it in making the single revolution being about equal to that required to make the four.

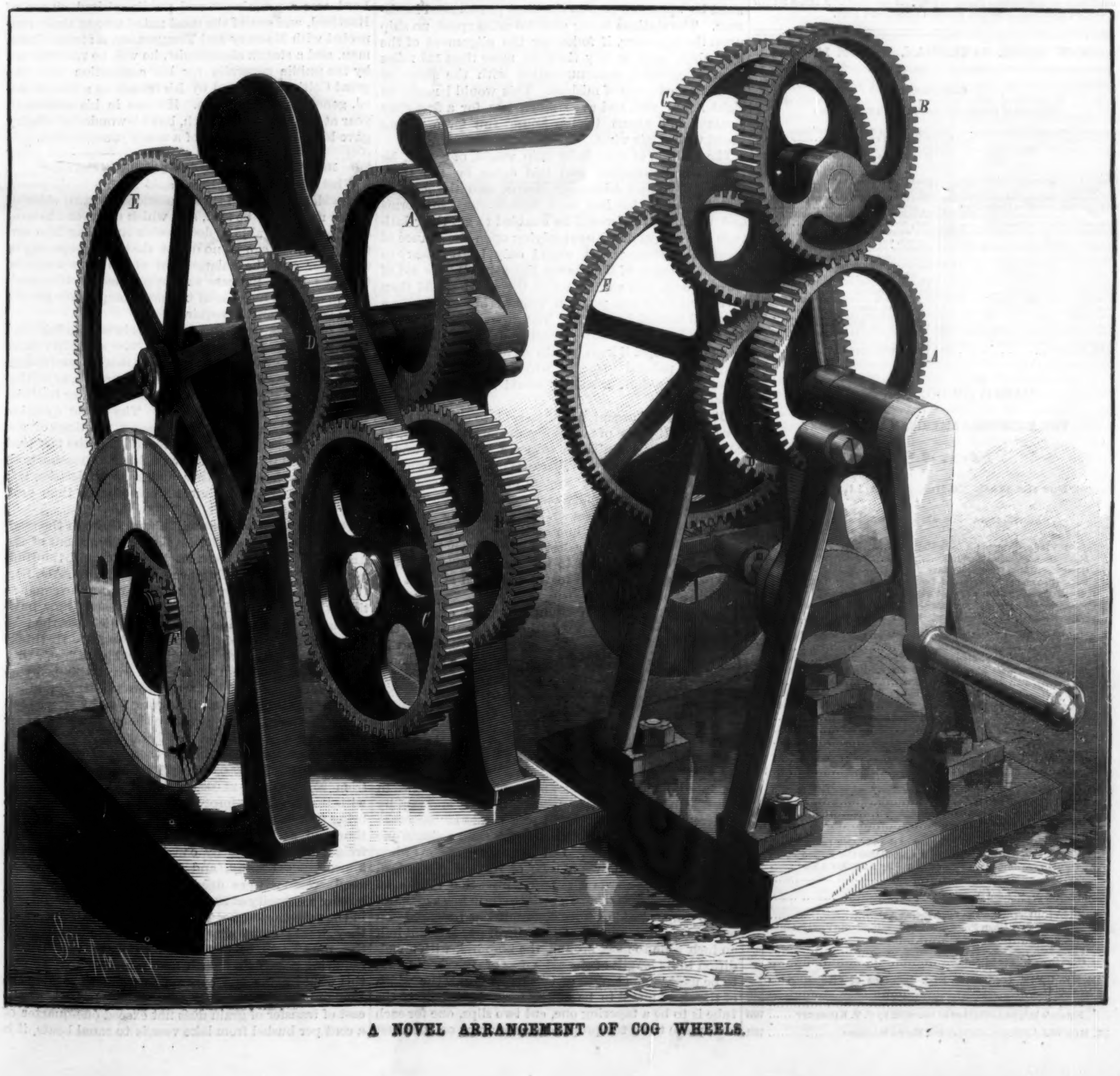
Two views of this planetary wheel train, designed by Professor C. W. MacCord, are shown in our frontispiece; the outline drawing, Fig. 2, is a side elevation, which clearly illustrates the way in which each wheel is mounted. With this train many peculiarly interesting results may be reached, and, considered as a new mechanical movement, it will undoubtedly be found to be particularly applicable to some practical purpose. Professor MacCord has devoted much time to this branch of science, and the train we are describing affords an original and unique illustration of the depth of research, the store of mathematical knowledge, and the skill in application which have marked all his labors in this line of thought.

The elliptical wheel, A, is rigidly secured to the frame, its major axis being vertical. Extending through the lower focus of this wheel is a shaft whose outer end is provided with a hand crank, and whose inner end carries a planetary arm, T (Fig. 2). One end of the arm is weighted, and the opposite end is journaled to receive a shaft which carries the second elliptical wheel, B (*a*, Fig. 2), on one end and the circular wheel, C (*f*, Fig. 2), on the other end, both wheels being rigidly mounted. The circular wheel gears with the pinion, D (F, Fig. 2), the shaft of which also carries the large circular wheel, E (all the figures), these being rigidly mounted also. This shaft is journaled in the rear standard of the frame, and is in line with the crank shaft. The large wheel meshes with a pinion on a shaft carrying a pointer moving in front of a dial plate. The relative sizes of the circular wheels and pinions will be understood from the engravings.

It is manifest that when the crank is in the position shown in the right hand view in the frontispiece the elliptical wheel, B, and the circular wheel, C, will attain their maximum velocity of rotation; this will decrease until the crank assumes a diametrical position, when the minimum rate will be reached. In the first mentioned position of the crank the wheel, D, will also assume its maximum rate of revolution, as will also the pointer. The axial motion of this wheel will decrease, and finally cease when the extremities of the minor axes of the elliptical wheels are in contact, the angular velocities of the axial and orbital motions of the pair, C D, then being equal. The crank handle will then be slightly below the center. The same result is reached when the opposite ends of the minor axes are in contact, the crank handle then being on the opposite side and slightly below the center. As the crank passes downward from either of these points, the pointer moves in a direction opposite to that in which it moved when the ends of the axes were approaching each other from above.

Beginning the revolution with the crank handle down, we obtain the maximum rate of the pointer; this diminishes, and the pointer rests when the handle has reached the position a little below the center. The direction of revolution of the pointer is then reversed, and it travels slowly while the handle is making a little more than the upper half of its revolution. When the handle passes the second contact point of the axes

(*Continued on page 164.*)



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THE SCIENTIFIC AMERICAN SUPPLEMENT,

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For the Week Ending March 14, 1885.

Price 10 cents. For sale by all newsdealers.

LIGHT-SHIPS ACROSS THE ATLANTIC.

In a recent number of the SCIENTIFIC AMERICAN, a correspondent signing himself C. G. R. advises the establishment of a chain of light-ships across the ocean, electrically connected with the shore. This plan is good but not original, having been suggested about a year ago by a member of the Institution of Civil Engineers (English). The latter, however, confined himself strictly to the scientific aspect of the scheme; but it would not be difficult to show that from a nautical standpoint, also, it is far from impracticable. The experience with light-ships proves that a vessel, if properly constructed, may be made to ride out the fiercest storms at anchor save upon rare occasions, and the light steel cables of recent construction have been successfully used to anchor ships in the deepest water "off soundings." Let us suppose a chain of light-ships, seven in number, to be stretched across the ocean from the Grand Banks to the shores of Ireland. Then the distance between shore and ship and between the ships themselves would be about 250 miles. Each ship would ride to a mushroom anchor, which would permit it to swing to the tide without fouling its anchor. Only a small dynamo-electric machine and engine would be required to keep an arc light aglow in the tops.

The deep sea cable extending along the whole line and connecting the light-ships with the shore could be brought to the surface near each ship and buoyed, so that electrical connection could be made or broken at will. Each vessel would have permanent moorings; the anchor cable being made fast to a buoy and not to the light-ship itself, so that, in case of peculiarly unfavorable conditions of weather, such as a hurricane, for instance, a light-ship could slip her cables and run before it or be hove to under a small trysail, or permitted to drift to leeward under a floating anchor, regaining her moorings when opportunity offered.

The advantages of such a system of light-ships must be apparent even to the most pronounced landsman. The stations being only 250 miles apart, no ship upon the high-seas, if following the alignment of the light-ship, need at any time be more than 125 miles from telegraphic communication with the shore or from succor in case of mishap. This would be only an eight hours' run, and even much less for a first-class steamer, and about twelve hours' run for a sailing vessel with a fair wind.

The position of each light ship would, of course, be accurately determined and laid down on the U. S. Coast Survey and Admiralty charts, and the masters of sailing ships that had been beaten about in storms and thick weather would be enabled to get their latitude and longitude without relying upon the chance of speaking a steamer. It would only be necessary to read the number of the nearest light-ship by the aid of their glasses, and a reference to the chart would then give them their true position, whence they could take a new and correct departure. The progress of the great Atlantic liners could be telegraphed daily to both America and Europe, if kept within sight of the light-ship, and that painful suspense which now attends the breaking of a shaft or rudder would rarely, if ever, be experienced.

Dispatches, if urgent, could be sent to ships in mid-ocean. In the case of fast going steamers, it would, of course, be impracticable to stop for these, nor would such a course be necessary, because by means of what is known as the "wig-wag" system of signaling ordinary messages could be rapidly exchanged between a light ship and a passenger steamer. This "wig-wag" system is based upon the principle of the Morse telegraphic alphabet, the dots and dashes of the latter being represented by waving a flag to the right and left by day and passing a white light to the right and left of a red at night.

Freighters and ocean tramps, instead of roaming over the seas inquiring of vessel after vessel where the best freights were being paid, could receive advices in mid-ocean from their owners or agents as to the most advantageous market.

MAKING A TUBE.

Straight tubes of sheet metals of all diameters from one-eighth of an inch up, of oval, and square, and octagon, as well as of cylindrical cross section, are rapidly produced in sheet metal manufactories either drawn in presses without seam, or formed in dies and rapidly soldered along the seam. These are sold at hardware and tool stores at a price much lower than a single one could be made by hand. But there are occasions when the machinist requires a tube of some non-standard diameter, or he needs a tapering pipe that cannot be readily found in stock. In order to form one a mandrel of the proper inside dimensions must be prepared—an ordinary iron mandrel. Cut a slip of paper about half an inch wide to meet around the mandrel, with an addition to its length of the thickness of the sheet metal to be used. The length of this paper slip is the width of the sheet metal to be cut to form the tube. If the tube is to be a tapering one, cut two slips, one for each end, place them the proper distance apart on the sheet metal to form the length of the tube, and draw lines from ends to ends.

After cutting out the metal form, bevel with a file the inner edges of the plate, so that when rolled up the outer edges will meet, while the inner edges do not quite come together, but have a V-shaped channel. The tube may be formed by laying the sheet over a V-shape score in a block of wood, placing the mandrel on its center, and beating on the mandrel with a mallet or a soft metal hammer; and the edges of the sheet may be made to meet by lightly coaxing with the copper or Babbitt metal hammer. When the edges meet, secure them with loops of fine wire, twisting the ends. See that the seam of the tube is clean, and then spread on it, inside, a paste made of borax calcined on a plate of iron or a pan of iron over the fire and mixed with water. Sprinkle on the seam inside some spelter solder, or the wire solder that is found at hardware stores; heat over a brisk flame fire, preferably of charcoal, and the solder will melt and make a good joint. Cool the completed tube, remove the binding wires, immerse the tube in a bath of one part, volume, of sulphuric acid to four parts water for a few minutes; wash in clean water, and scour with sand or emery.

HORACE LORD.

Horace Lord, the superintendent of Colt's Works, Hartford, Conn., died in that city Feb. 28, after a brief illness. Perhaps as much of the wonderful success of these celebrated works was due to him as to any other person excepting Col. Colt himself; for Mr. Lord was not only a practical mechanic, but also the inventor of a number of machines and of improvements in the methods of production of the famous revolving chamber pistols that are so intimately associated with the name of Col. Samuel Colt. Mr. Lord was connected with Col. Colt from the first beginning of the pistol business in 1851 as assistant superintendent, and subsequently as the chief superintendent. Although Mr. Lord was a prominent and public-spirited citizen of Hartford, and one of the most noted among those connected with Masonry and Temperance, a strong Union man, and a stanch abolitionist, he will be remembered by the public generally for his connection with the great Colt's works, and by his friends as a kind hearted, generous, genial man. He was in his seventieth year at the time of his death, but his wonderful vitality gave him the appearance of a much younger man.

HOW SHALL THE ERIE CANAL BE IMPROVED?

Whether or no the Erie Canal should be deepened and widened is one of those questions on both sides of which much may be said, and which not even the most experienced are able to decide with anything like certainty. There can be no doubt that the deepening of the water and the enlargement of the locks would be followed by an increase in the business of the canal; but would this increase of business compensate for the extraordinary outlay required?

Less than a fifth of the freight between Buffalo and New York now takes to the canal, whereas thirty years ago it carried nearly nine-tenths. Is this because the canal has been permitted to remain unimproved, or is it because the growing commerce demands greater facilities and a quicker mode of transit? The whole question was under discussion at two recent meetings of the American Society of Civil Engineers, and the fact that able and well informed men were found espousing both the one side and the other, and that no decision was finally reached, shows that it is one of more than ordinary difficulty.

The discussion was brought about through the reading of a paper on "The Radical Enlargement of the Artificial Waterway between the Lakes and the Hudson River," by State Engineer E. Sweet, M. Am. Soc. C.E. Mr. Sweet is in favor of enlarging the canal so that it can accommodate the largest vessels now navigating the lakes, and so as to even anticipate the lake vessel of the future of still greater draught. He thinks the canal should have a depth of 18 feet at least, with a width at the bottom of 100 feet. But this is by no means all that would be required to make the canal the most natural highway for that great Northwestern commerce to which, in Mr. Sweet's opinion, it would under more favorable conditions fall heir.

Mr. Sweet roughly estimates the cost of this work at $125,000,000 to $150,000,000, and its annual tonnage at from 20,000,000 to 25,000,000 tons. He believes that with the canal so improved it would be possible to bring freight to New York from Chicago in quicker time and at less cost than is now required to bring freight from Buffalo by canal. Against these radical improvements many, and it must be said some very good, reasons were urged. The large lake vessels, having a capacity of 90,000 bushels of grain, would cost in the neighborhood of $100,000 and require large crews; they would move slowly in an artificial waterway, the round trip between Lake Erie and the Hudson requiring possibly a month and sometimes more, and this would make the expense so great as to give the Welland Canal a palpable advantage. Indeed, as the cost of transfer of grain does not exceed one-quarter of a cent per bushel from lake vessels to canal boats, it is

difficult to see how there could be much, if any, advantage in not breaking cargo and using large vessels for the round trip.

What seemed to be the most feasible plan of those suggested was that of obtaining a uniform depth of 10 feet in the canal, which it was estimated would not cost more than $2,000,000 or $3,000,000 at the outside, and using steam canal boats. With this depth, these could be made to carry from 18,000 to 20,000 bushels of grain, and make the round trip between Lake Erie and New York in from 8 to 10 days.

DOCTOR DOWLING ON PNEUMONIA.

The presence of this dread disease has been very great in many parts of the country during the last few weeks, and in this city it has proved quite fatal, taking away a number of our most respected citizens. Dr. J. W. Dowling, Professor of Diseases of the Heart and Lungs in the Homœopathic Medical College of New York, was interviewed the other day by a representative from one of our daily newspapers, and in answer to an inquiry from his interviewer replied:

"There is beyond a doubt a great deal of pneumonia now prevalent. How much of it there is cannot be definitely known, as physicians are not required to make report on this disease to the Board of Health. There are two distinct sorts of acute pneumonia," the Doctor proceeded to state. "The one is due to an extension of bronchial catarrh from the air tubes to the lungs proper. This may come from a cold, and generally does. It attacks children, old persons, and people who are prone to pulmonary diseases. This is the broncho-pneumonia, and may be complicated with other troubles. This exists at all times, but is more prevalent in cold, damp, and changeable weather, and makes a shorter finish of people who are predisposed to pulmonary troubles, or who are on the road to the grave with consumption, etc. The other form of pneumonia is what is known as croupous pneumonia, and here the disease starts directly in the lungs, and the symptoms are a severe chill, followed by fever and bloody spittle. This form of pneumonia is infectious in so far as it is the result of a specific poison which produces pneumonia and nothing else. It is not contagious, but does sometimes appear to be epidemic. I should say that not over 10 per cent of those who are attacked die of this complaint. This is a general estimate, and it includes all those who are stricken down in this city. In our school of practice," says the Doctor, "we have been very successful in treating this disease. Our treatment has been with aconite, phosphorus, and bryonia, with flaxseed jackets and hot fomentations in some cases. We are careful in avoiding the morphine treatment and the administering of stimulants, which the old school believes in. Only this month I brought through an old lady seventy-six years of age who was attacked with croupous pneumonia involving the lower and middle lobes of the right lung.

"These poison germs which I spoke of may exist in your body now or in mine, and yet a good condition of bodily health may enable us to keep off the disease, and the germs have no chance to develop themselves. It may be that exposure to cold, or trouble, or overexertion, or grief, or any one of a thousand ways in which the vital energy may be reduced, will cause the croupous form of pneumonia to show itself. Dissipated people are particularly subject to it. No, I would not say exactly dissipated people, but men who take their three or four glasses of whisky a day and seem to be in the very best of health, and yet are very far from being so. They fall very quickly when the attack comes on. To a physician's eye, when he comes to look into the history of the case, the explanation is very simple. The sudden changes in the weather bring on those reductions of bodily vigor and energy which permit the germs to develop quickly in the lining of the lungs and in the substance of those organs, and owing to lack of resisting power, the result of indiscretions, death soon follows. All persons should be very careful at this time in avoiding exposure to this changing atmosphere and these violent weather conditions, and to live carefully, and then with proper care and timely application of remedies this particular form of pneumonia is not very difficult of control. In cases where it seems to be contagious, the history of the subsequent cases will show this reduction of vital energy to which I have referred."

An Aeronautical Exhibition.

The Aeronautical Society of Great Britain proposes to take a practical step toward the attainment of the end for which it was established, by holding an Aeronautical Exhibition at the international one to be opened at the Alexandra Palace next month. The Aeronautical Exhibition itself will, however, not begin until June. The objects for exhibition will be: 1. Models of designs for the accomplishment of aerial navigation by mechanical means only. 2. Models of designs for the accomplishment of aerial navigation partly by buoyancy and partly by mechanical means. 3. Models constructed to elucidate either of the two last objects, which are capable of flight and carrying their own motive power. 4. Machines constructed upon a scale calculated to carry a weight equal to that of a man, upon the principles advocated by the inventors. N. B.—The practicability may be demonstrated by the flight of a model of similar character, and of weight-carrying capacity sufficient to enable a judgment to be formed as to the probable efficiency of the large machine when actuated by the power necessary for its support and propulsion, whether by manual or mechanical methods. 5. Light motors. N. B.—It may be observed that light motors are in request for other purposes than aerial navigation. But for the latter object it is essential that extreme lightness shall be a condition. Therefore only a motor possessing that qualification in proportion to its power with the smallest consumption of fuel (in the case of steam) or other adjuncts, and capable of working up to one horse power at the least for twenty minutes, will be deemed deserving of the prize. 6. Balloons, navigable or otherwise. 7. Balloon material and appliances for propulsion or otherwise. 8. Kites or other aerial appliances of that character, for saving life at sea, for traction, or otherwise. 9. Objects of interest connected with aeronautics.

The Washington Monument Alleged to be in Danger.

We have received from Mr. John C. Goodridge, Jr., an engineer of great experience in the construction and repair of heavy foundation works, a pamphlet in which he not only criticises very severely the mode followed in underpinning the Washington Monument, but shows substantially that the present foundation is so weak and unreliable that the structure is liable to give way at any time and fall to the ground.

His criticisms appear to be worthy of notice. If the monument is in a dangerous condition, prompt precautions should be taken to guard the approaches to the work from the public, and operations for strengthening the supports should be undertaken without loss of time.

Mr. Goodridge states that his attention was called to the subject as early as 1877, when he submitted to the Joint Commission a plan for the insertion of a strong and substantial foundation, also a copy of his patent explanatory of his general system.

Thereafter, as appears by official reports, Engineer Casey's plan was adopted by the Commission, and the work was begun. The Casey plan appears to have been derived from the Goodridge method in its general features, except that the parts of the Goodridge plan which secured real strength and solidity in the foundation were left out.

In his original proposal to the Commission, Mr. Goodridge describes his plan as follows:

"First.—To inclose the present foundation with a circumscribing wall of beton of high tensile strength, the beton wall going below the present foundation.

"The strength of this wall may be increased by the insertion of iron rods, chains, etc.

"Second.—From the circumscribing wall tunnels are carried to the foundation, and under it if necessary.

"The details of this process are described in the patent which I inclose. The ribs may be increased until the foundation is entirely encircled with beton, or inverts may be made between them. The shape of this new and sub-foundation may be likened to a cart wheel laid flat on the ground, the monument being on the hub.

"By this method you not only get a large area, but from the center being higher (as a wheel is dished), the outer circle must be forced apart, and the earth behind it forced out, before any settling can occur.

"Such a structure would be like an inverted saucer, and a monolith.

"We replaced the foundation of the Portage Bridge on the Erie Railroad, and it has answered perfectly. The bridge was 240 feet high, and trains constantly passing. Some of the piers were in a rapid current in the Genesee River."

Colonel Casey describes the plan adopted as follows:

"It is believed the work can be successfully accomplished by introducing the masonry in thin vertical layers, not over four feet in width, having first tunneled under the structure with drifts of that width and the required height and length. These layers can be connected to each other by dowel stones set in the faces of the layers as the work progresses, and with panel depressions in the alternate layers, into which the intermediate layers would be moulded. The material of the layers will be strong Portland cement concrete except, possibly, for a short distance just under the old foundation, where rubble masonry may be forced in and wedged up under the stones of that structure."

Commenting on the above, Mr. Goodridge says:

"The shaft is 55 feet square, resting upon a loose mass of rubble masonry without tensile strength, and is stated in the reports of the engineers as unable to bear any transverse strain.

Under this shaft of 55 feet square is left an opening 45 feet square. The walls of the monument are 15 feet thick, and the new foundation extends but 5 feet under this wall, leaving that portion of the shaft giving the greatest pressure as a dead load to be carried by the clay portion of the upper soil. It is evident that the greatest weight comes just where the new foundation stops. This new foundation or footing course extends outside beyond the line of buttresses, forming a leverage caused by the greater pressure at the center of the monument. These separate sections have no sustaining bond to hold the mass together, and it is within the strong possibilities that this, by making new positions, will cause a new set of strains which the structure is unable to bear.

It is evident that the pressure is greater immediately below the monument than on the outside of the concrete footing course, and in this construction more than in ordinary masonry, because the blocks of concrete are unconnected and placed side by side. There are no superimposed courses with overlapping joints. Now, all the concrete footing course that extends beyond the buttresses has not only less pressure than the other portion, but from that fact makes a point of enormous leverage, the tendency being to force the central portion down and out, tearing apart the lower portion of the old foundation, and crowding the top of it together through the medium of the buttresses. Leaving out the detrimental effect of the concrete footing that goes beyond the line of buttresses, and considering the foundation to end there, we have as the area covered by buttresses 101½ feet square, equal to 10,302 square feet, disregarding fractions. Deducting from this the unsupported portion of 45 feet square in the interior, we have remaining 8,277 square feet to carry the weight of 21,953 pounds, or nearly eleven tons, to the square foot on the bottom of the concrete footing course and on the soil beneath it.

We will have added to our constant load over three tons of wind pressure per square foot, which, with the load, makes about 28,000 pounds, or fourteen tons, per square foot.

If the concrete footing blocks had extended to the center of the monument, then the load would have been distributed in a different manner. As the main pressure of the weight of the monument comes near the inside of the footing course, and as such pressure must exceed the pressure on the perimeter of the foundation, we look to find a greater settlement at the inner point. We have enormous leverage transmitted through the buttresses to the old foundation, which from the reports given of it must be unable to withstand such a force; while the strains on the old shaft will be brought to new points by the changes of position, and lead to its dismemberment.

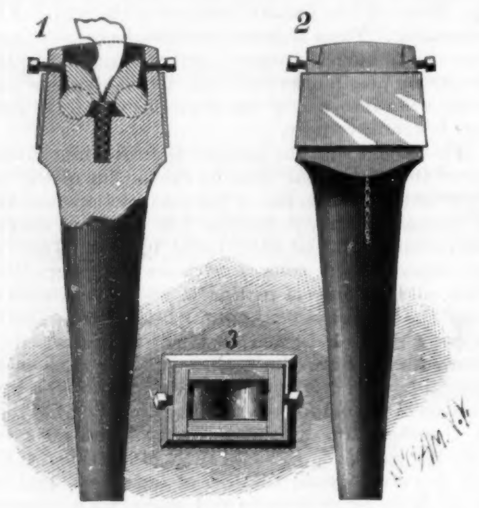
In regard to the concrete foundation, we are told that it is composed of one part cement, two parts sand, three parts pebbles, four parts broken stone. My occupation since 1870 has been the manufacture of beton and concrete, and since 1875 almost entirely in strengthening foundations, etc., and I have never thought it safe to use so weak a material as the one described. The only advantage that I can see in the proportions is that the numerical order is an aid to the memory of the mixers, and perhaps lessens the strain on the mind of the engineer. It is difficult to understand how such a mixture could be thoroughly compacted; and when we find that the upper portion was rammed in in gunny bags, we do not know how all the vacuities could be filled, except by the settling of the structure above it. Taking the load and the wind pressure combined, we have a distributed pressure on one side of the monument of nearly 200 pounds to the square inch; it will be in excess of that in some portions at certain points.

How long such a structure can stand under the pressure as described is simply a matter of supposition. Experience shows, as stated in one of the reports on the Washington Monument by Government engineers, that even on overloaded soil 'protracted time is necessary to produce sensible results.'

It has been demonstrated that a monument can be raised to the height of 555 feet on such a soil as underlies the Washington Monument, but that it can be sustained there, is still to be proved."

AN IMPROVED SAW SWAGE.

The saw swage shown in the accompanying illustration consists in two eccentric swages pivoted in a socket, and capable of receiving between them the point of the saw tooth, the object being to spread the points of the teeth when the swage is driven forward,



YOUNG'S SAW SWAGE.

without diminishing their length. The adjoining faces of the eccentric swages are nearer the center of rotation than the outer portion, so that when the swages are caused to revolve by the insertion of the tooth between them, the faces of the swages will approach each other and operate laterally upon the opposite edges of the tooth. In our engraving, Fig. 1 shows a side elevation, partly in section, of the swages pivoted in their socket; Fig. 2 representing the exterior of the implement, and Fig. 3 an end or top elevation. In Fig. 1 can be seen the adjusting screws and spiral spring resting in a cavity in the shank, which hold the swages in position. The shank and the swages are made of steel, hardened and properly tempered, and with sufficient strength and rigidity to stand the lateral pressure created by driving the implement upon the tooth, whereby the tooth is elongated rather than upset, as in the usual manner of swaging.

This invention has been patented by L. B. Young, and further information can be had by addressing Messrs. Young & Lewis, of Villa Ridge, Ill.

IMPROVED SCROLL SAW.

Amateur scroll sawing, for the making of a great variety of household ornaments and useful articles,

THE HOUSE SCROLL SAW.

has steadily grown in popularity for a few years past. One can so readily become proficient in the operation of the machines devised for this purpose that their use has come to be a favorite diversion among the young people in many families throughout the country. Among the latest improved devices of this kind is the House patent scroll saw, shown in the accompanying illustration. It has been a popular style of saw for years, being light enough for a lady to lift around, making but little noise while running, and being very durable, although sold at a low price; but it has lately been materially improved by the addition of three inches to the swing, making nearly sixteen inches in the clear, and a positive blower, which keeps the work entirely free from dust.

In our engraving, Fig. 1 shows the cam which springs the arm for tension; Fig. 2 is a rubber ball with tube attached, each downward stroke of the saw arm forcing air through the tube; Fig. 3 is the pitman rod, to which the lower end of the saw blade is clamped. The moving arm of the saw is made of malleable iron, and is attached at the center of the bow to an iron frame. The surface of the saw table, on which the wood rests, is on a level with the screw attaching the movable arm at its center to the iron frame, so the overcut is so slight that it is overcome by the pressure of the wood against the saw blade. The saw blade has always the same strain at any position of the stroke, so that few saws are broken, and the treadle bar is hung on Λ-shaped bearings, like those of a letter scale, causing the machine to run very easily. The machine is light, and of great power, being made entirely of iron and steel except the pitmans and wood tables, the latter being of black walnut, filled and finished.

The House scroll saw is manufactured by Mr. A. H. Pomeroy, of 216 to 220 Asylum Street, Hartford, Conn.

The Poiograph.

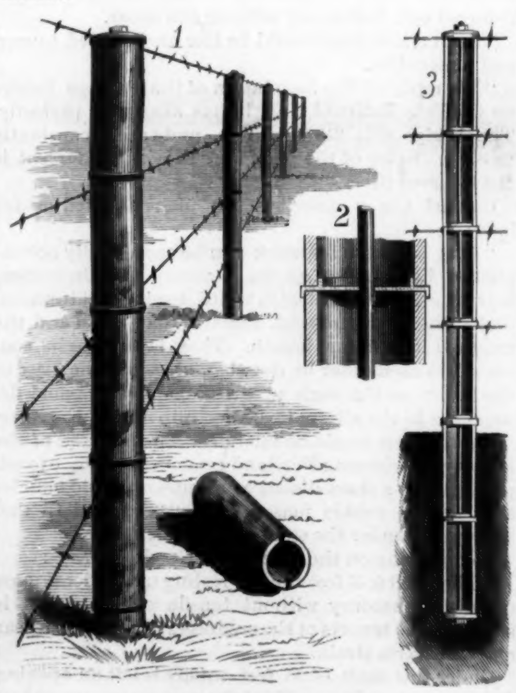
Mr. C. H. Hinton lately read a paper before the Physical Society on "The Poiograph." As the result of a process of metaphysical reasoning, Mr. Hinton has come to the conclusion that relations holding about number should be extended to space. Starting from the premises that the relation of a number to a number is a number, *e. g.*, the relation of 6 to 2 is 3, the author proceeds to carry these principles into the considerations of space, and concludes that when properly understood the relation of a shape to a shape is a shape, and that of a space to a space is a space. The shape that shows the relation of a shape to a shape is called a poiograph. To form a poiograph, the content of each shape is neglected, and the shape is represented by a point, each point being by its co-ordinates representative of the properties of the shape considered. The resultant shape is a poiograph.

A SECTIONAL TILE FENCE POST.

The post illustrated by the accompanying drawing is especially adapted for barbed wire fences. It is constructed of common drain tile, in sections varying in length according to the desired distance between the wires, each section having a notch or groove across the upper end to hold the wire. The ends of the posts are provided with bottom and cap pieces, and through the whole passes a light iron rod, having a head at the bottom of the post and a burr at the top. Between each section is placed a thin iron washer of the same diameter as the post, with a hole in the center fitting the rod that passes through it. The construction will be readily understood by reference to the illustration, Fig. 1 showing the post in position holding its wires, Fig. 2 the detail of joining the sections, and Fig. 3 the interior of Fig. 1. The post is set the same as the common wooden post, and tile of an outside diameter of four inches is sufficient. The fence wire is tightened and placed in the notches between the several sections, the burr is turned down on each post, holding the fence, wire, and posts all firmly in place.

Among the advantages claimed for this style of fence post are, first, great strength, the washers between sections conveying all lateral strain to the highly tensioned connecting rod, making the joints remarkably rigid; second, durability, as a fence constructed of wire and sectional posts of hard tile as above is fireproof and practically indestructible by the weather; third, economy, as the posts can be so constructed and sold cheaply, and whenever a section is accidentally broken, the post is easily repaired by insertion of a new section. No new machinery is needed for the construction of these posts, all machinery required in their manufacture being already in daily use.

The patentee of this new fence post is Mr. E. R. Anable, of Paw Paw, Mich., and John Hodges, of the same place, as assignee of a one-half interest, to either of whom letters relating to the patent may be addressed.



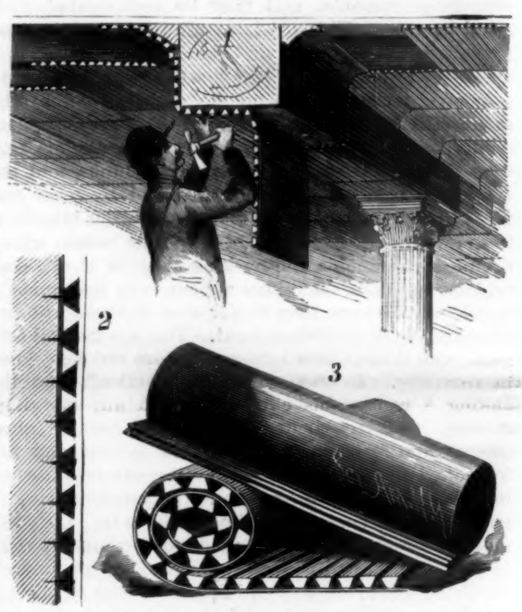
ANABLE'S TILE FENCE POST.

The Steepest Railroad Grade.

There are several steep grades on railways in this country. The Atchison, Topeka & Santa Fe has one over the Raton Mountain, the steepest portion of which is 285 feet to the mile. The Denver & Rio Grande climbs at one place a grade of 220 feet per mile, but the J., M. & L. takes the lead, which is found on what is known as the Madison hill. Length of hill, 2 miles; average grade, 211·86 feet per mile; grade at steepest part (7,000 feet long), 307·30 feet per mile. On this hill are used two engines. The passenger engine, light, exclusive of the tender, weighs 89,600 pounds; eight drivers. Freight engine, light, exclusive of tender, weighs 112,300 pounds; ten drivers. All weight on drivers. This hill has been the source of much trouble to the company. Various experiments to overcome the grade have been tried, and abandoned. The third rail with cog face, in which worked a cog driver, was brought into requisition, which for a short time worked quite satisfactorily, but of necessity was abandoned, and followed by the present pattern of engine in use, low, heavy, all weight on drivers, with as many drivers as practicable.—*Indianapolis Journal.*

IMPROVED LATH.

The illustration herewith represents an invention of an improved web of lath, Fig. 1 showing its application on a ceiling, Fig. 2 being a side view, and Fig. 3 showing the manner in which it is furnished ready for use. The novelty consists principally in attaching lath to a flexible backing, to facilitate the application of lath to the joists of a building, and to cause the plaster



MORRISON'S IMPROVED LATH.

to key closely to the lath. It is preferred that the lath sticks be attached to the backing by means of tar or other adhesive material; the backing also serves as a good "deafening" for the wall.

This invention has been patented by Mr. James Morrison, Jr., 122 West Seventeenth Street, New York City.

Turtle Oil.

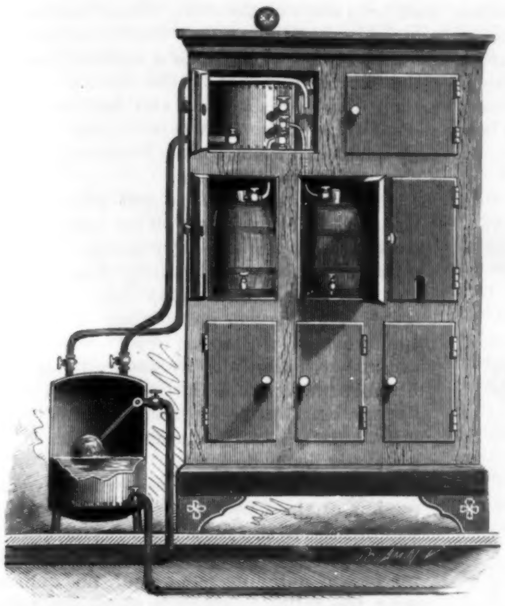
Turtle oil is suggested as a substitute for cod liver oil. The oil is of a yellowish color, and at the ordinary temperatures in this country forms a thick, finely granular fluid, in consistence something like olive oil partly congealed. A gentle heat renders this oil clear and transparent. It possesses little odor or taste, and does not quickly turn rancid. Taken in warm milk it is not so objectionable as cod liver oil. Mr. E. M. Holmes, in the *Pharmaceutical Journal*, says:

"Mr. J. H. Brooks informs me that the oil is obtained from the fat of the reptile by boiling, and not from the eggs. Concerning its use in medicine, Mr. Brooks adds, 'I have for some twenty years employed turtle oil with the most beneficial results in all cases where cod liver oil was indicated, in persons in whom the nutritive process was defective, in children of strumous disposition, in the *sequelæ* of scarlet fever, in measles, and other acute specific diseases. It has proved of the greatest service in scrofulous affections of the eyes, nose, and other parts; and has been most beneficial in chronic bronchitis, gout, rheumatism, and syphilitic affections; but I have found it more particularly useful in phthisis pulmonalis, in all its stages. Turtle oil is borne well by the stomach, causing neither nausea, eructations, dyspepsia, nor diarrhœa. It should be administered in the same doses as cod liver oil, commencing with a small dose three times a day, in any vehicle that the patient may fancy. It is also largely used in the Mauritius and Reunion, where pulmonary diseases prevail, and is much preferred to cod liver oil.'"

This animal oil, which keeps well, and is comparatively free from smell, should prove, with its color and non-drying properties, of great service in the manufacture of pomades, etc.

A REFRIGERATOR AND AIR PRESSURE APPARATUS.

The illustration herewith shows a refrigerator in which two different currents of air are set up, as desired, one for the purpose of cooling the inside of the refrigerator, by passing over ice therein, and the other for cooling the contents of the beer kegs, etc., placed in the refrigerator. In our engraving the tank at the left is for water, a pipe connecting with a water head; this



HEINTZ'S AIR-PRESSURE REFRIGERATOR.

tank is filled under such pressure until the automatic cock shown shuts off the supply, and then, by a waste pipe, the water is let out until the tank is nearly emptied, the air again filling the space. The air forced out by the water rising in the tank passes through one or other of the two pipes out of the top, one of these pipes leading into a closed air chamber, and the other into the refrigerator where the air chamber is situated. From this air chamber pipes lead to the beer kegs in the refrigerator, so the cooled air is supplied under pressure to the beer in the kegs. The air delivered into the refrigerator is passed over ice, salt, ammonia, etc., making a continuous current of cold air, not only around the compressed air chamber, but all the other contents of the refrigerator. The patent for this improvement is supplementary to one issued to the same inventors about a year ago, this invention especially covering the placing of the air tank inside the refrigerator, so the air in the tank may be lowered in temperature before it is admitted to the beer kegs.

Those desiring further information in regard to this refrigerator and air pressure apparatus should address the patentees, Messrs. Christian and George M. Heintz, of 263 Michigan street, Buffalo, N. Y.

THE PNEUMATIC PULVERIZER.

The accompanying engraving represents a machine which has been designated by its inventor as the "Pneumatic Pulverizer," and the object of which is to reduce the broken pieces of any solid body, such as stone, ore, etc., to an impalpable powder.

The principle of the apparatus, which is essentially a new one, is based upon the use of two jets of superheated steam, so adjusted as to carry along continuously the fragments to be pulverized. These fragments moving with great velocity, clash against each other with enormous force, become divided by the shock, and very quickly reach the desired degree of tenuity.

The stone, ore, or other product that is to be reduced to powder must be previously broken into pieces of about a quarter inch in diameter, and this is done by means of a stamping and crushing mill that is likewise of recent construction.

The material thus reduced is put into a large hopper, E (Fig. 2), which is bifurcated at its base. The steam required for the work is generated in a large tubular boiler capable of maintaining a pressure of from 15 to 20 atmospheres. The steam is superheated to about 600° C. by passing through a worm over the fire place, between the latter and the boiler. The jet of steam enters through pipes, G and H, that lead to nozzles that are so adjusted as to mathematically face each other, and which are three and a half inches apart. In passing through these nozzles the current carries along the particles with great velocity.

It is easy to imagine the violence of the shock that the material experiences, when we reflect that the pressure used for producing the two opposite currents is from 15 to 20 atmospheres, according to the degree of fineness to be obtained and the product to be pulverized. The powder produced by this collision is carried along and passes through a conduit to the collecting chamber, which is itself heated by a worm, so as to prevent any condensation of steam. A chimney provided with wire cloth prevents the powder in suspension from escaping to the exterior, and causes it to fall back, while the current of air finds an exit.

After the shock, nothing but the dust is carried along, and this traverses a sieve before reaching the collecting room. The particles that are less divided drop to the bottom of the apparatus and are carried by a chain and buckets up to the hoppers.

The entire plant consists of the following apparatus: 1, a generator, with superheater; 2, two pulverizing apparatus; 3, a stamping and crushing mill; 4, a steam engine and boiler for actuating the stamping and crushing mill; 5, an apparatus for feeding the hoppers; and 6, a room for collecting the powder obtained.

The boilers are of 20 horse power for a double apparatus, and weigh 11,000 pounds. As for the pulverizers, the heaviest piece weighs 220 pounds, and all their parts are made so as to be interchangeable.

This is an American invention, and is in extensive use in the United States, especially at gold and silver mines.—*La Nature.*

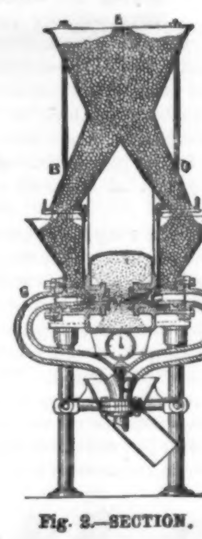


Fig. 2.—SECTION.

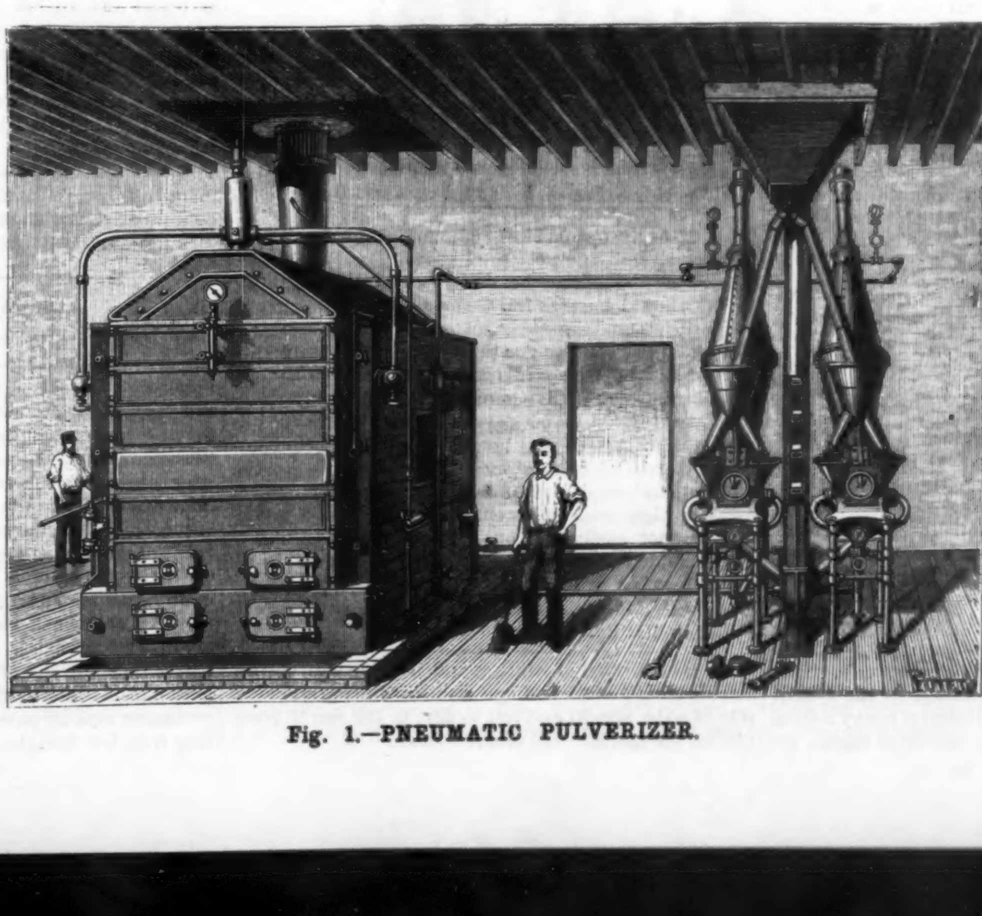
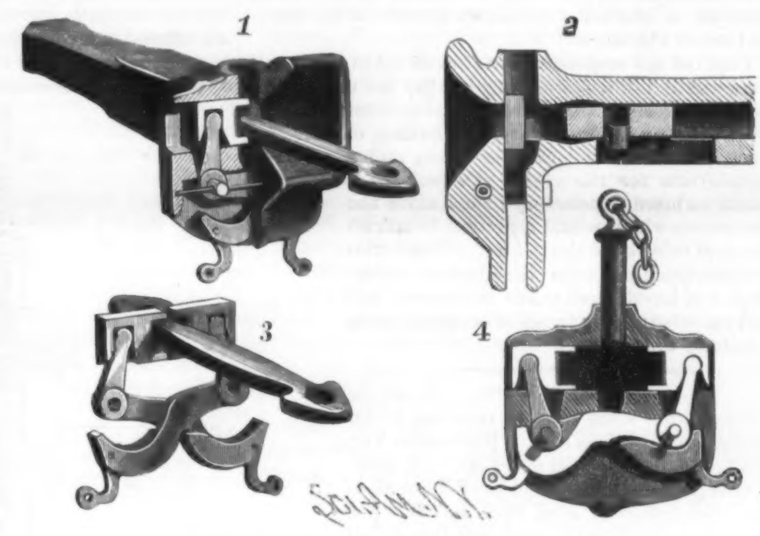


Fig. 1.—PNEUMATIC PULVERIZER.

A DOUBLE AUTOMATIC CAR COUPLER.

The car coupler shown in the accompanying cuts presents many admirable features which commend it to the attention of those who have use for or are interested in such appliances. It serves a double purpose, being automatic with the pin and link commonly in use, thereby saving the expense of new devices, and also dispensing with the pin and link as they give out. The connecting bar used with this coupler may be made much stronger and more durable than the ordinary link, and it can be used in the old style drawhead, as it is formed with holes in the ends for the reception of pins. The jaws moving in the drawhead are actuated by the weight of self-adjusting levers that operate between the walls of the head on the under side. The weighted levers can be raised, for uncoupling, from either the top or sides of the car. When necessary to use a link, the jaws may be thrown away from each other, as shown in Fig. 4, to permit the entrance of the link. Fig. 2 is a longitudinal section through Fig. 1, in which parts are cut away to show the inside of the drawhead; Fig. 3 is a perspective view of the jaws and levers by which they are operated; and Fig. 4 is a face view having the jaws spread.



VAN DORSTON'S DOUBLE AUTOMATIC CAR COUPLER.

Further particulars regarding this coupler may be obtained from the inventor, Mr. A. W. Van Dorston, of Portland, Oregon.

Black Birch for Inside Finish.

Black birch for doors, wainscoting, and other interior work is being introduced to a considerable extent in new buildings, and it is certainly one of the handsomest of the many variety of woods that are being introduced into new houses, while the cost is much less.

Black birch is a close grained wood, and is as easy to work as walnut, and is much cheaper than either walnut or cherry. There is great difference in the quality and color of birch, that growing upon high and dry land being hard and susceptible of good polish, while the growth on swampy land is soft, and therefore not well suited for the purposes the upland product so admirably fills. The writer in constructing a new house last year had birch folding doors introduced against the protest of his architect, who had never heard of birch wood being used for that or any analogous purpose. The result is most satisfactory to all parties, and to none of us more than the architect, who preferred the use of walnut or cherry. Possibly the builder took especial care in the selection of his material, so as to convince the architect of his error and his (the builder's) superior knowledge; but, however that may be, the black birch doors, which in texture resemble satin wood, and in color dark cherry, are the admiration of every one who has seen them.

Birch grows in our northern latitude, and the trees attain considerable height and size in localities, and there is a species of bird's eye birch which is well calculated for furniture. It resembles bird's eye maple, and when polished it possesses that sheen which renders satin wood so pleasing to the eye. We predict for black birch an important place among the fancy woods for house finishing and furniture.

A NOVEL ARRANGEMENT OF COG WHEELS.

(*Continued from first page.*)

the pointer stops, and then moves in the direction it first assumed as the handle approaches the lowest position. In the model before us the pointer makes about 3½ revolutions while the crank is moving downward between the two contact points, and makes about one revolution when the crank is moving upward between the points. It will be understood that the rate of motion of the pointer increases from nothing each way from each contact point, the two maximum rates being attained as the handle passes the vertical line above and below the center.

Those of our readers who are interested in these subjects will find it a fascinating but by no means easy task to ascertain the speed of the pointer when passing a certain location, having, of course, assumed sizes for the wheels and a certain rate for the crank. Or perhaps it would be more satisfactory to calculate the two curves which would represent the direction and velocity of the pointer. Those who are attracted because the device accomplishes a novel mechanical movement will find their best skill taxed to construct such a train of wheels.

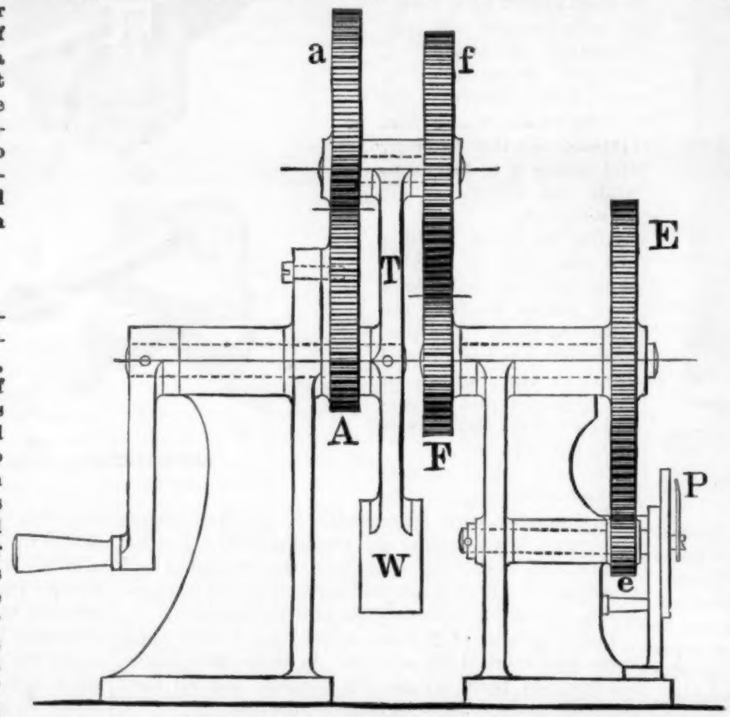


Fig. 2.—A NOVEL ARRANGEMENT OF COG WHEELS.

Slate-Tar Roof.

Some years since we had occasion to examine a very curious roof in Burlington, Vermont, designed and put on by Mr. C. C. Post, of that place. It combined most if not all of the essentials of a good roof, and as it was not a patented design, and was free to all who wished to use it, we took some pains to investigate its construction and ascertain its durability. The pitch was as flat as is usually seen. The material was slate laid in a compound of coal tar and slate dust or coal tar and Portland cement. The roof was first covered with matched boards in the usual way. The tar was then prepared by adding Portland cement to the tar till it became thick enough when cold to stick to the slate, and at the same time not stiff enough to chip or crack. Where slate dust can be obtained, this is quite as good. The mixture is made so stiff that it will not flow in the hottest weather, and at the same time will not crack in cold weather. Lime would be a valuable ingredient, as it would neutralize the acid of the tar. If more convenient, a ready prepared roofing tar, like that of the Warren Chemical Company, may be used. When the tar is ready, a strip of roof is covered, and a line of slates bedded in it very much as tiling would be laid, but having from ½ to ¾ of an inch between their edges. In this way each slate has its full surface exposed to the weather. When the whole roof has been laid, all the seams or joints are paved with the tar. The slates are laid so as to break joints like bricks in a wall, the horizontal lines, or those running across the slope of the roof, being continuous. In this method of construction the slate forms the wearing and weather surface, protecting the tar bedding, while the thickness of the tar at the joints and the small quantity exposed to the weather make it apparently as durable as could be wished. The roof of which mention has been made has been on for several years, and is as sound and perfect as when first laid. It has during this time needed no repairs, and bids fair to last for many years longer as sound as when first laid. Apparently, there is no reason why such roofs, should not last as long as plain slate. They bear walking over without damage, and if from any cause a slate is broken or cracked, it can be easily repaired. Cracking of the slate does not always cause a leakage. This style of roof will probably not take the place of all other kinds of roofing material, but it will no doubt be a very valuable addition to the different methods of roof covering, since it gives a flat roof with the generally desirable characteristics of slate.—*Nat. Car-Builder.*

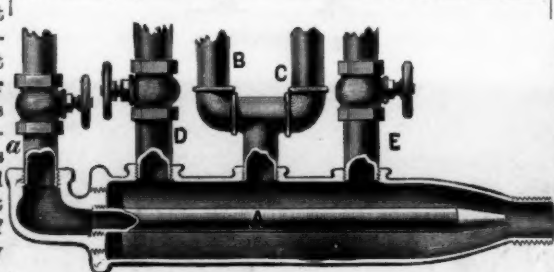
Safe Loads on Iron Columns.

Navier gives one-fifth of the breaking weight as the safe load in practice. Francis, an American engineer, also gives one-fifth, while Morin adopts one-sixth. My present opinion is that cast iron pillars supporting loads free from vibration, such as water tanks, will safely carry one-fifth of their breaking weight. In factories or stores, where moderate vibrations occur, the working load should not exceed one-sixth; and if the pillar be liable to transverse strains, or severe shocks like those on the ground floors of warehouses, where loaded wagons or heavy bales are apt to strike against them, the load should not exceed one-tenth of the breaking weight, or even less in some cases, where the strength of the pillar depends rather on the transverse strain to which it is liable than the weight it has to support. For instance, the effect of wind on a light open shed supported by pillars may produce a transverse strain which will be very severe in proportion to the weight of the roof. The same thing may occur if heavy rolling goods, such as provision kegs or loaves of sugar, are piled up in such a manner as to cause horizontal pressure, like that of a liquid. It is also necessary to take into consideration the foundations on which the pillars rest, for if these yield unequally, one pillar may sustain much more than its proper share of load.—*B. B. Stoney, in the Architect (London).*

A SUCTION FITTING FOR STEAM HEATING APPARATUS.

The illustration herewith shows a recently patented device to apply to steam heating apparatus, either in connection with a steam trap or otherwise, by which the circulation is increased, and the heat obtained is augmented in a corresponding ratio. A represents the feed or suction pipe which works the fitting and creates a vacuum; *a* is the steam pipe from coil getting steam nearest the boilers, supplying the steam to work the fitting, and should always connect direct with the strongest coil or radiator, to have as dry steam as possible, which coil should also be the one most constantly in use. B and C may be said to represent one floor of a building, or the waste pipes leading from it, all of which should be collected to come into the fitting at one point, D and E being pipes from other floors, all coils being so connected as to have a fall into the fitting.

This fitting obviates the snapping and cracking noises so often heard in steam pipes, and when used with a trap it operates by sucking all the water of condensation out of the pipes and forcing it into the trap; it is also of great benefit where the condensation water is returned to the boiler, a check valve being used between the fitting and the boiler. Where a building is already piped to return the water of condensation to the boiler, the returns must be connected to come into the suction fitting, and the strongest coil used to work the fitting by creating a vacuum and forcing the circulation. The fitting may be set either vertical or horizontal, but should have as few turns as possible between it and the steam trap.



McDANIEL'S PATENT SUCTION FITTING.

In many cases where the present steam apparatus is insufficient, the use of this fitting will supply the desired increase and give more heat. This has been found true in a marked degree where the fitting has been employed in drying houses where a high and sustained degree of heat is one of the necessities of the business, and woolen manufacturers who have used it speak in high terms of its efficiency. It is not expensive, cannot easily get out of order, and is highly recommended as a standard fitting attachment in all steam heating work. It is manufactured by Messrs. Watson & McDaniel, No. 248 North Eighth Street, Philadelphia, Pa.

A PASTE formed of whiting and benzine will cleanse marble from grease, and one made of whiting and chloride of soda, spread and left to dry, in the sun if possible, on the marble, will remove stains.

The California Whale Fishery.

Few people are aware of the extent of the whale fishery on this coast. There are many little coves along the coast of California where the hardy and daring whale catchers live in an unobtrusive manner, with no particular expense except cheap, strong clothing and plain and wholesome food. They have no operas to attend, few or no taxes to pay, no fences to build, or streets to grade, or lands to plow. Their home is on the sea, with brief stays on the shore, where their duties consist in changing blubber to oil, which they put in barrels till they obtain enough for a shipment, when they lash the barrels together in the form of a raft, signal an empty lumber schooner, and float the raft of barrels of oil to the schooner, where they are hoisted on board and taken to San Francisco, where they are turned into gold.

Already during the present season nine whales have been caught off the Los Angeles coast and taken into Portuguese Bend, a quiet cove about eight miles west of San Pedro, where about thirty men are constantly employed in harpooning these monster beasts of the ocean, or in towing them ashore, cutting up the carcass, rendering the blubber into oil, and putting the same into barrels, extracting the whalebone, and sending the refuse of the animal out to sea to avoid pestilence on land.

Probably not a thousand persons in this section of the State have any idea of the magnitude of the business of whale fishing on this coast, so quietly is it carried on, with no public announcement and no quarrel with the railroad company about the price of freight. The company at Portuguese Bend have six large whale boats, besides yawls and the usual rowboats needed on such occasions. One of the nine whales recently taken out of a school of whales passing by Portuguese Bend going south was what is called a "cow whale," and yielded ninety barrels of oil. The whales going south yielded about four hundred and fifty barrels of oil, and the same school in their northern trip may yield as much more.

At San Diego six whales have been taken that yielded 300 barrels of oil, and the whalers expect to capture a large number from the school or troop of whales now moving north. There are about eight other stations on the coast of California where these quiet hunters of the sea are engaged in their arduous but profitable duties. All the stations appear to be doing well this year, but the stations south of Point Conception appear to have smoother water and better fortune than those farther north.—*Los Angeles Herald.*

Ancient Use of Vermilion.

Native cinnabar, or vermilion, a sulphuret of mercury, was first prepared by Kallias, the Athenian, five hundred years before the Christian era. There was a minium or cinnabar wrought in Spain from stone mixed with silver sand; also in Colchis, where they disengaged it from the fronts of the high cliffs by shooting arrows at them. Pliny and Vitruvius call it minium, and Dioscorides observes that it was falsely thought by some to be the same as minium. Vermilion is the color with which the statues of the gods were painted. It was abundant in Caramania, also in Ethiopia, and was held in honor among the Romans. Their heroes rode in triumph with their bodies painted with vermilion, and the faces of the statues of Jupiter were colored with this pigment on festal days. The monochrome pictures of the ancients were wrought with it. There was also an artificial kind of cinnabar, a shining scarlet sand, from above Ephesus. Vitruvius and Pliny say that vermilion was injured by the light of the sun and moon. To prevent this result, the color was varnished by a mixture of wax and oil. Sir Humphry Davy found vermilion in the Baths of Titus.—*William Linton.*

Habits of the Abyssinians.

Mr. F. Villiers, the well known artist of the London *Illustrated News*, accompanied the English Commissioners to Abyssinia, and he gives an interesting account of the customs of the people. He states that they are great consumers of milk, but never use it in a fresh condition. They do not artificially sour it, but the vessels in which it is placed are never cleaned, and thus immediately when the fresh milk is poured into these, fermentation commences. Meat, of which the Abyssinians are great consumers, they eat raw, and when guests are invited to sit down at a feast a bullock is slaughtered in an adjoining apartment as they wait, and strips are cut off while the flesh is still hot—sometimes, indeed, before the animal is absolutely dead. In eating, the native puts one end of a strip of meat into his mouth, holding the other in his left hand, and with his sword or dagger cuts off piece by piece close to his nose, cutting from left to right.

Correspondence.

Pumping up Water Forty Feet.

To the Editor of the Scientific American:

Referring to query No. 76, January 31, the following experiment may interest some of your readers. While exhibiting a rotary pump at a county fair, we raised water by suction forty feet high quite successfully, using the following arrangement at the foot of the suction pipe: We placed an ordinary globe valve to close the pipe tight, and a ¼ in. air cock tapped into the pipe just above the valve; before starting the pump we primed it, so that the piping was completely filled with water. As soon as the pump started, the vacuum gauge marked 27 in.; we then opened both the air cock and the globe valve very slowly, until the gauge went down to 24 in., when the pump began and continued to discharge a stream of air and water. We then by the use of a 3-way cock turned this stream into a large air chamber provided with an air cock at the top and a fire hose at the bottom. This separated the water and air, and delivered a steady stream under a pressure of about 30 lb. per sq. in. We could not get any higher pressure, as we were obliged to keep the air cock on the air chamber open in order to take care of the air taken in at the suction pipe.

The theory we worked upon was that a column of air and water can be raised as much higher than a column of water as the first is lighter than the last, limited, however, by the fact that only a small quantity of air can be mixed with the water before it will begin to separate in the suction pipe,

Respectfully, A. H. L.

Watertown, N. Y., 30th Jan., 1885.

[The above is correct, but requires a quick movement of the pump to make it successful. When the pump is stopped, the water cannot be started again without the repetition of the priming and special manipulation. It might be a serviceable device for special cases.—ED.]

A New Use for Safe Deposit Vaults.

One of our well known New York seed firms has now on deposit in the Mercantile Safe Deposit Company's vaults four hundred pounds of Henderson's snowball cauliflower seed, which at the selling price of one hundred dollars per pound shows the value of this seed to be forty thousand dollars. Not only is this plan of depositing in vaults found to be cheaper than insurance, but what is of more importance is that if the seed should be destroyed by fire this quantity necessary for their trade could not be replaced at any price in time for the spring sales. When it is considered that four hundred pounds of cauliflower seed will under favorable conditions produce nearly thirteen million plants, which when headed for market and sold at even 8 cents per head will produce the sum of three-quarters of a million dollars, the value this vegetable has attained in this country, where twenty-five years ago it was almost unknown, becomes readily apparent.—*The American Garden.*

To verify the above statement, which seemed to us rather extraordinary, we wrote to Mr. Henderson, the well known seedsman of this city, to inquire if the account was correct. He replies as follows:

To the Editor of the Scientific American:

In reply to your inquiry respecting the employment of safe deposit vaults for storing seeds, I would say that by accident we got possession of a small quantity of the cauliflower seed that had been grown in an out of the way place in Europe some ten years ago; and in a test in our trial grounds with our other kinds of cauliflower we found this so much superior in every respect that we determined to have it grown in quantity, and did so, and have so far been able to keep the secret of its source from the rest of the trade—a very important matter in our business. What we state about it is strictly fact; that we have over 400 pounds of it in the company's vaults, the retail price of which is $100 per pound. This is the first season that we have placed it in the vaults, as in making our list of goods for insurance we found that it would be more profitable to us to pay for the space in the vaults than to pay insurance on it in our regular warehouses. Besides, it would have been difficult to make any insurance company believe that we had so much value in so little bulk. Moreover, we find that the uniform temperature of the deposit vaults is the best in which seeds can be kept, and it is probable that we will further use them for many of our valuable seeds.

PETER HENDERSON.

February 24, 1885.

Loss of Wealth by Fire.

In this country the losses by the burning of buildings and their contained property are about one hundred millions of dollars per annum, and the losses of lumber by the burning of forests are estimated at three hundred millions yearly; in all, four hundred millions of dollars. Could these enormous losses be stopped, the country would soon grow very rich.

Sidney Gilchrist Thomas.

On the 1st of February, at Paris, after prolonged illness, Sidney Gilchrist Thomas died, aged 34. This announcement will send a pang of sorrow through the iron and steel world. It is no exaggeration, remarks *Engineering*, to say that the most promising light of the steel world has now gone from among us. To know him was to admire him. The rapidity with which the invention, so associated with the name of Sidney Thomas, has been brought to its present importance is very remarkable, but that he considered his labors, in his peculiar sphere, unfinished is to be taken for granted, and up to within a few days of his death he was pursuing his work with all the strength of mind and body which, after a prolonged illness, he could command. So inseparable was labor to him that, being too ill to dictate, he wrote himself, and his correspondence, occasioned by the numerous patents he had taken out, the success which he lived to see realized in so many of them, and the experiments based on his ideas which he organized, occasioned a mass of correspondence at once very voluminous and very difficult. The outline of the history of the basic process is soon told.

Starting the idea with his cousin, Mr. Gilchrist, the experiments at Blaenavon were rapidly brought to a success. The first paper by Messrs. Thomas and Gilchrist was offered for reading at the Paris meeting of the Iron and Steel Institute, 1878. It was placed near the top of the list, but at the last moment was removed, and before the news of the change could reach us a part of it appeared in *Engineering*. This attracted so much attention that the paper was read at the next meeting. Trials were made at Dowlais, at Eston, at Thy-le-Chateau, and at Hoerde; success was then insured, and the rapid adoption of the process throughout the Continent followed.

In April, 1882, a second joint paper was read at the Society of Arts, and obtained the society's medal. In the autumn of the same year, at Vienna, Mr. Thomas was presented with a most chastely designed casket, made entirely of basic steel. This graceful acknowledgment of his work was presented by Herr Baumler, on behalf of the Prager Eisenindustrie Gesellschaft. His labors meanwhile were largely directed to the erection of the Northeastern Steel Works, Middlesbrough; these were started in June, 1883, and since then they have led the van of the basic process in England. In September of the same year, Mr. Thomas was presented by the Council of the Iron and Steel Institute with the Bessemer gold medal; and the letter he wrote to the president on that occasion, almost attributing the success of his inventions to others, is eminently characteristic of him. With excellent taste, under the circumstances of his absence, the presentation was personally made by Sir Henry Bessemer.

Since that time all endeavors to ward off the lung disease which had struck him down had failed, and sea journeys to milder climates, and residence in Algiers, were in vain. He returned to Paris in the summer of last year, where he obtained the highest medical advice; but death overtook him. During the last fortnight he was gradually sinking. His request to his relatives was that they should not be asked to take another winter journey on his account, and to lay him where he died.

Some Facts about Dynamite

Nothing is more common than to hear people express surprise, in view of the recent dastardly outrages in England, that the manufacture and sale of dynamite by irresponsible parties is not strictly prohibited by law. This, however, has been done, and so far as the law can be executed, there is no danger. The trouble lies in the ease with which the explosive can be made.

The base of all the higher explosives is nitro-glycerine, which is formed by the action of concentrated nitric acid, in the presence of strong sulphuric acid, upon glycerine at a low temperature; great care has to be taken in regulating the temperature during the operation, but upon a small scale the nitro-glycerine may be readily prepared by dropping the glycerine into the mixed acids, the mixture being kept artificially cooled. Of course glycerine, as also nitric and sulphuric acids, are so widely used medicinally and for industrial purposes as to make their purchase an easy matter, where nitro-glycerine itself would not be sold. But with the nitro-glycerine which can be produced therewith, can easily be made dynamite of any degree of strength, by just mixing with infusorial earth, sawdust, charcoal, or even with sugar, or any one of many similar substances—these latter just serving to soak up and hold the nitro-glycerine. The strongest dynamite is that in which infusorial earth is used, that will soak up three parts by weight of nitro-glycerine to one of its own.

For commercial purposes dynamite is packed in cartridges of various sizes, from one to two inches in diameter, and about eight inches long. It is commonly supposed that dynamite is easily exploded by concussion, but under ordinary conditions this is not the case. Neither is it exploded by fire. It is easily ignited, and in burning gives a most intense heat; but it cannot, usually, be made to explode in this way when unconfined. The ordinary way in which it is exploded is by means of fire and concussion at the same instant. For this purpose a strong copper percussion cap containing fulminate of mercury is used. Without the cap the cartridge is not considered dangerous by those accustomed to handling it, and the cap is not inserted until just before the cartridge is to be used.

The best dynamite is about twelve times as powerful as gunpowder, and is very effective for blasting purposes. It freezes at about 45°, and it is almost impossible to explode in a frozen condition. It may be used under water. The paper shell of the cartridge has a covering of paraffine, which is not easily penetrated by water; but even if the dynamite is wet its explosive properties are not destroyed, though if it remain in the water any length of time the glycerine is washed out, and the destructive value of the compound lost. There is a marked difference in the explosion of gunpowder and dynamite; the former, if placed on the floor of a building and exploded, might blow out the windows without seriously injuring the structure; but dynamite exerts a powerful force downward, and for this reason is used by the so-called "dynamiters," as they can hastily place it anywhere in a building, without confining it, as would be necessary with gunpowder.

The Texas Salt Lake, La Sal del Rey.

This remarkable salt lake, which has attained a widespread celebrity, is situated in the county of Hidalgo, Texas, about forty miles north from Edinburgh, the county seat, which fronts the old Mexican town of Reynosa, on the opposite side of the Rio Grande del Norte, and about seventy miles northwest from Brownsville. Its geographical position, as shown on the maps, is about 26° 32' north latitude, and 98° 4' west longitude. It lies in the broad prairie that stretches from the Rio Grande on the south to the Nueces on the north and the Gulf of Mexico on the east, but is immediately surrounded by a wide fringe of dense thickets, composed of guisache, ebony, mesquite, and other different varieties of trees indigenous to the country. It is embraced within the limits of a tract of seventy-one leagues of land, orignally known as "La Noria de San Salvador del Tule," claimed to have been granted by the government of Spain, about the year 1798, to one Juan Jose Balli.

It is in form an ellipse, about one mile in length and five miles in its circumference. Its depth nowhere exceeds three or four feet, and its bed consists of pure rock crystal salt. The water is a brine of unusual strength, which crystallizes with such rapidity that no matter how large a quantity of salt is removed from the bed of the lake one day, its place will be found filled with salt of a similar quality the next. This indicates that the supply of salt is practically inexhaustible, while in purity it ranks with the best rock salt productions of this continent or of Europe, being composed of 99·0897 parts chloride of sodium, or pure salt.

An analysis of it, made in 1860 by Dr. Riddle, then Assayer at the Mint in New Orleans, gave the following result:

Matter insoluble	0·5108
Sulph. magnesia	trace
Chloride sodium	99·0897

All salt is more or less mixed with impurities, the only known exception being the product of the Wieliczka mine, in Poland, which is one hundred parts pure chloride of sodium, or salt. The best salt is pure rock salt, in which class that of Wieliczka stands at the head; but in general commerce it is practically unknown, in consequence of its remote inland location. It has, nevertheless, for centuries been the source of a princely revenue to its proprietors, and often constituted the dower of royal brides.

In this country there are only three sources for the supply of rock salt, viz., Holston, Va., the Petite Anse, La., and La Sal del Rey, Tex.

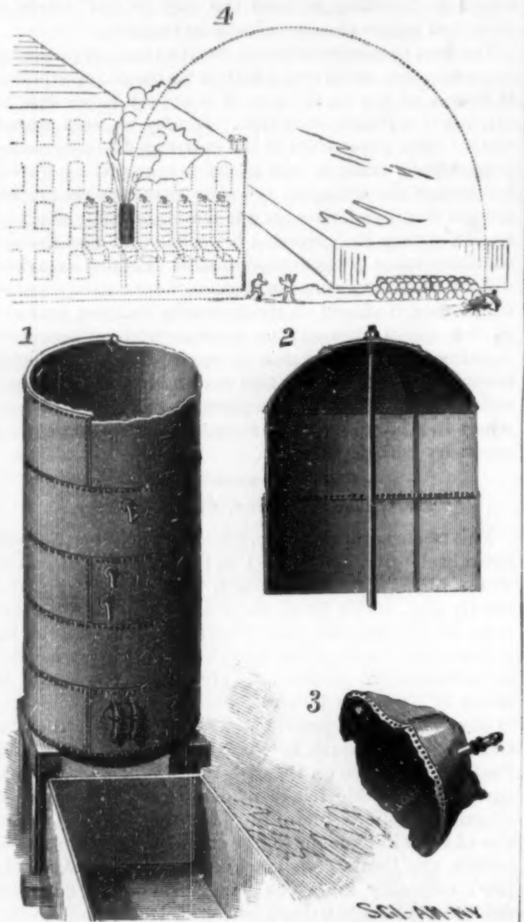
La Sal del Rey and its surroundings have never been geologically examined or explored. The indications are that the powerful brine, which crystallizes into rock salt in its bed, is merely an exudation from an adjacent mine of rock salt, equal, perhaps, in purity to that of Wieliczka, the slight percentage of impurities it contains being probably acquired by the brine while percolating through adjoining strata.

IT was discovered upon examination not long ago, that a chimney 80 feet high at a machine shop at Holyoke, Mass., was about 42 inches out of perpendicular. The method employed in righting was quite simple. A harness was located under the cornice, and two others below the first. Two lever jackscrews were placed under the girders of one of the harness on one side, and six jackscrews similarly on the other side. The earth was then carefully loosened about the chimney on the opposite side from that of its inclination, and water poured in, after which the jackscrews were turned gradually, and the earth again loosened and dampened with the hose. After this process had been several times repeated the earth was puddled, and the whole stands now properly righted.

EXPLOSION OF A LARD BOILER.

A somewhat curious accident occurred on the 14th of January, at Messrs. James Morrison & Co.'s pork packing establishment, situated on the corner of Bank and Riddle Streets, Cincinnati, Ohio.

There is at the rear of the main building a lard rendering house in which are eight rendering tanks (see Fig. 1). The night man noticed a flame of fire at tank No. 3 (shown in shaded lines), and immediately had an alarm turned in, but before the engines arrived the fire had spread to such an extent as to completely envelop the tank. As the tanks are subject to steam pressure, the pressure in this one was raised above the usual point, causing it to explode with a loud report, the domed top being projected through the roof and floors, and falling about 100 yards away, on some barrels of grease, crushing one of them in its descent (see Fig. 4).


A LARD BOILER DURING, BEFORE, AND AFTER EXPLOSION.

These tanks are 6 feet in diameter and 14 feet high, and are made of about five-sixteenths inch iron, single riveted; the heads are domed outward, and are stayed by one long $1\frac{1}{4}$ inch bolt passing from head to head, secured by nuts; they are supplied with steam from a pipe passing along the line of tanks, having a regulating valve at each, and are each provided with a safety valve set at about 40 pounds per square inch.

Under ordinary circumstances these tanks are strong enough perhaps, but it is necessary to provide for all contingencies, especially when we consider that the men in immediate charge of such apparatus are not first class machinists, although they are fully competent for their work of attending to this process; it may therefore be worth while to consider how the construction of these tanks may be improved.

By reference to the cut, Fig. 2 and Fig. 3, and as stated above, the heads are domed outward and stayed as described by a bolt; the objection to this plan is that the fluctuations of pressure cause a constant buckling at the flange where the head joins the shell, which the stay does not wholly prevent, and in time the head will crack at the flange, or the shell will crack near the point of junction.

Suppose the heads were domed inward and the stay added, and perhaps radial stiffeners fastened on to heads; they would be so stiff that buckling could not take place.

The necessity for some such plan as above can be seen, when it is noticed that the heads are further weakened by each having two large man lids in them.

Although the fire burnt the beams and floors only, this tank had much fire round it; but suppose all or any of the other tanks had exploded, how many lives might have been sacrificed! As it was, only one man was injured by a falling beam, and no one killed.

A. R. P.

EXPERIMENTS WITH THE SIPHON.

Professor G. M. Clayberg, teacher of physics in the West Division High School, Chicago, sends us the following:

Some very instructive experiments may be performed in the following manner:

Take a piece of ordinary glass tubing about 5 mm. in internal diameter and one meter long. Fifteen centimeters from one end bend it to an angle of 100°, and five centimeters farther to an angle of 90°. Draw out the other end to a point, and grind off the point so as to leave a hole about one millimeter in diameter. Twelve centimeters from this end bend it twice at right angles in the same plane as the bend at the other end. Grind off the large end obliquely. When finished, the siphon will be as in the illustration.

Place the large end in a vessel of water in which a little aniline red has been dissolved, and support the apparatus high enough so that the whole siphon can be seen by all the class. Start the water, and of course it will run. Lift the siphon so that the opening of the large end is partly out of the liquid, and you will have the beautiful appearance of a succession of spaces filled alternately with the colored liquid and with air. The length of these spaces can easily be regulated by raising or lowering the siphon a very little. Again lift the siphon entirely out of the liquid until fifteen or twenty centimeters of air have entered, and then lower it into the liquid again. The long bubble of air will pass slowly down the long vertical part of the tube and then up the short and pointed arm until it reaches the small opening, when it will rush out with great velocity. The rapid escape of the air gives the liquid behind it great velocity, and when it reaches the small opening at the end of the tube it is suddenly checked, producing considerable pressure—pressure enough to throw a few drops of the liquid ten or fifteen feet high, easily seen when the drops strike the ceiling of the class room.

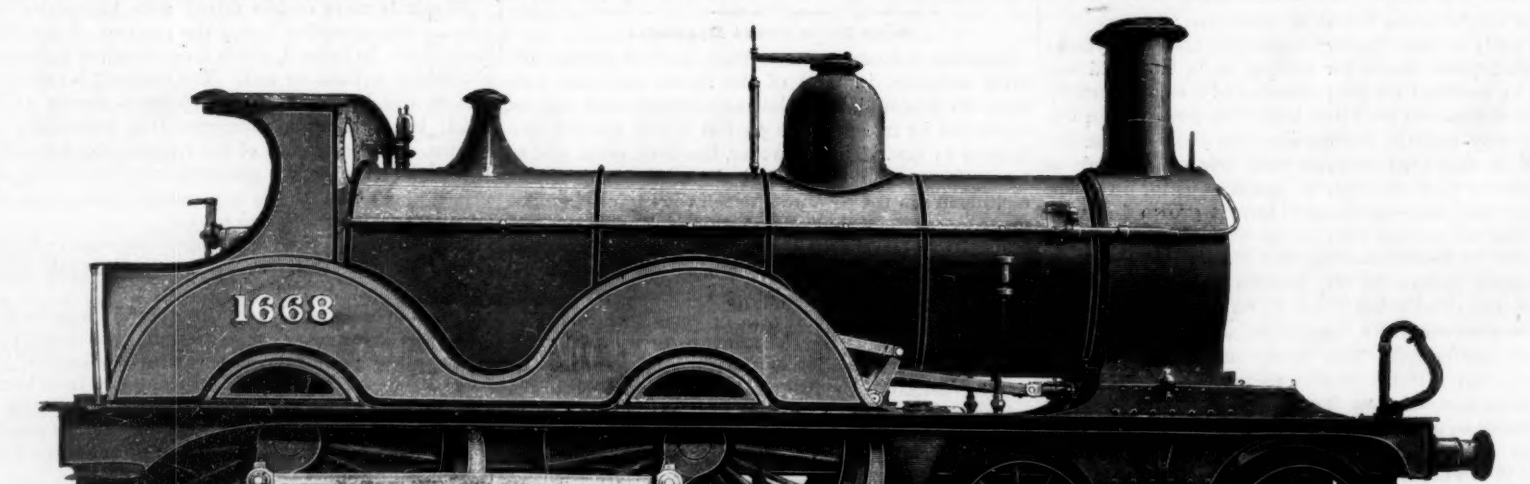

EXPERIMENTS WITH THE SIPHON.

This sudden arrest of the velocity of the flowing liquid illustrates the principle of action of the hydraulic ram.

FOUR-COUPLED BOGIE ENGINE, MIDLAND RAILWAY.

We illustrate one of several new engines of a very powerful character, put to work within a few months on the Midland Railway, England. They have been designed by Mr. Samuel Johnson, locomotive superintendent of the Midland Railway, and were built under his supervision at the Derby works of the company. The cylinders are 19 inches in diameter, and the valves are placed on top, there being no room between them, and are worked by Joy's valve gear, which is now being very largely employed for locomotives.

These engines are employed in working the express traffic between London and Nottingham, the fastest traffic in the world, the average speed being, says the *Engineer*, 53·5 miles an hour, with loads of nine to ten coaches. The consumption is only 27 pounds to 29 pounds per mile, of common Derbyshire coal. The heaviest gradients are 1 in 119 for $3\frac{1}{2}$ miles, and about 5 miles of other gradients of 1 in 162 to 1 in 177. These engines also work the Leeds and Derby mail with sixteen to eighteen coaches; speed, 45 miles an hour, with



FOUR-COUPLED EXPRESS LOCOMOTIVE, MIDLAND RAILWAY, ENG.

a bank of 5½ miles of 1 in 100 on the line between Sheffield and Dronfield.

The principal dimensions are as follows:

PARTICULARS OF BOGIE EXPRESS PASSENGER ENGINE, JOY'S MOTION.

	ft.	in.
Cylinders—		
Diameter of cylinders	1	7
Stroke	2	2
Length of ports	1	1⅛
Width of steam ports	0	1⅝
Width of exhaust ports	0	4
Distance apart of cylinders center to center	2	0
Lap of slide valve	0	1⅛
Lead of slide valve	0	3/16
Motion—		
Diam. of piston rod (steel)	0	2¾
Length of slide blocks	0	10
Length of connecting rod between centers	6	2¾
Wheels and Axles—		
Diameter of driving wheel on tread	7	6
Diameter of trailing wheel on tread	7	0
Diameter of bogie wheels on tread	3	6
Distance from center of bogie to driving	10	0
Distance from center of driving to trailing	8	6
Distance from driving to front of firebox	1	8½
Distance from center of bogie to front buffer plate	5	3
Distance from trailing to back buffer plate	4	4
Wheel base of bogie	6	0
Crank Axle (Iron)—		
Diameter at wheel seat	0	8⅛
Diameter at bearings	0	7½
Diameter at center	0	7½
Distance between centers of bearings	3	10
Length of wheel seat	0	6⅝
Length of bearings	0	9
Trailing Axle (Steel)—		
Diameter at wheel seat	0	8⅛
Diameter at bearings	0	7½
Diameter at center	0	7¼
Length of bearings	0	9
Diameter of outside coupling pins	0	3⅛
Length of ditto	0	3⅛
Throw of ditto	0	12
Bogie Axles (Iron)—		
Diameter at wheel seat	0	6⅛
Diameter at bearings	0	5¾
Diameter at center	0	5¾
Length at wheel seat	0	6
Length at bearing	0	9

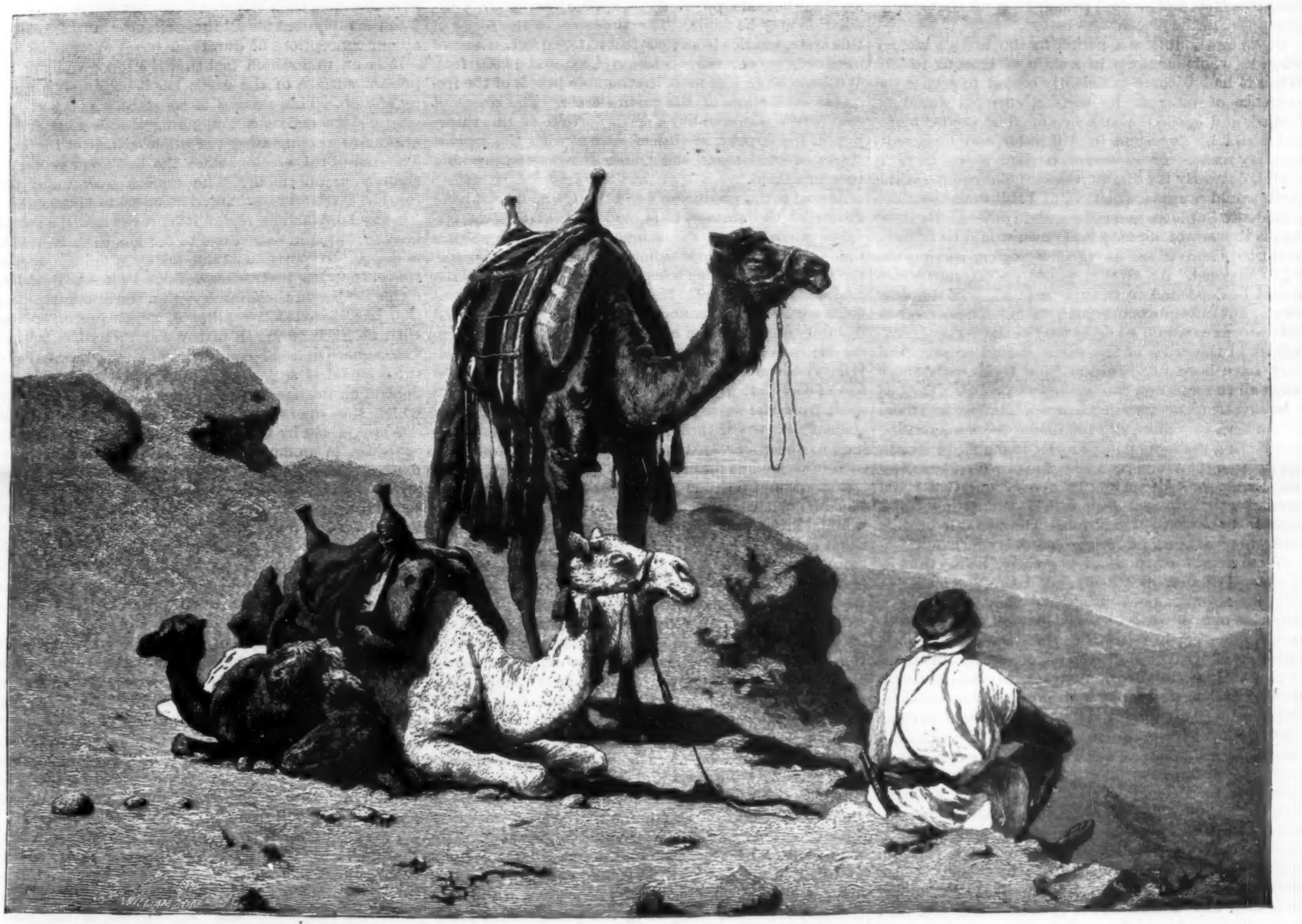
	ft.	in.
Distance between centers of bearings	3	7
Tires—		
Thickness of all tires on tread	0	2¾
Width of all tires	0	5½
Frames—		
Distance apart at leading end	3	11¾
Ditto at trailing end	4	1⅛
Thickness of frames (iron)	0	1
Boiler—		
Center of boiler from rail	7	4
Length of barrel	10	6
Diameter of ring next to firebox	4	3
Thickness of plates (iron)	0	½
Thickness of smoke-box tube plate	0	¾
Lap of plates	0	2½
Pitch of rivets	0	1⅞
Diameter of rivets	0	11/16
Thickness of butt strips, outside	0	½
Thickness of butt strips, inside	0	7/16
Width of butt strips	0	7½
Firebox Shell—		
Length outside	5	11
Width outside at center line of boiler	4	4
Ditto at bottom	4	½
Thickness of front plates	0	9/16
Thickness of back plates	0	½
Thickness of side plates	0	½
Distance apart of copper stays	0	4
Diameter of copper stays	0	⅞
Inside Firebox—		
Length at bottom, inside	5	8
Width at bottom, inside	3	4⅛
Top of box to inside of shell	1	8
Depth of box inside, front	5	11½
Depth of box inside, back	5	4⅛
Tubes (Copper)—		
175 diam.	0	1¾
30 "	0	1⅛
Total No. of tubes 205		
Thickness, 11 and 13 B.w.g.		
Diameter of exhaust nozzle	0	4⅝
Height from top of top row of tubes	0	⅛
Height of chimney from rail	13	1⅛

Heating Surface—	sq. ft.		
Tubes	1011·459		
Firebox	110·163		
Total	1121·622		
Area of grate	17½		
Engine Empty—	tons.	cwt.	qr.
Bogie	13	14	2
Driving	13	12	2
Trailing	12	4	1
Total	39	11	1
Engine in Working Order—			
Bogie	14	16	3
Driving	15	0	3
Trailing	12	18	3
Total	42	16	1

Tender Empty—	tons.	cwt.	qr.
Leading	6	10	0
Middle	6	6	2
Trailing	6	0	2
Total	18	17	0
Tender in Working Order—			
Leading	10	17	3
Middle	12	5	1
Trailing	12	0	0
Total	35	3	0
	lb.		
Adhesion	12,544		
Tractive power at 100 lb. mean pressure	11,173		

THE EGYPTIAN CAMEL SERVICE.

Those who have an idea that the desert regions of Upper Egypt and the Soudan are simply a dead level, a sort of ocean of sand, have greatly mistaken the actual physical configuration of the country. The artist in the accompanying illustration, for which we are indebted to the London *Graphic*, has sought to give us a view of the desert as it really is, the rocks and hills alternating with sandy plains to make a country rugged of aspect, where the absence of water precludes all vegetation, and the naked, glaring surface seems to almost equally forbid animal life. And this is the character of the country for hundreds of miles along both banks of the Nile, up to the great central African plateau. Long before the First Cataract is reached, at Assouan, five hundred miles above Cairo, these sterile wastes approach quite up to the river banks, and all travel over them is fraught with great labor and hardship.



A REST IN THE DESERT.—FROM A PICTURE BY C. RUD. HUBER.

The difficulty of sending soldiers through such a region was the most serious matter which presented itself to the British Government in organizing its expedition for the relief of Khartoum, and the idea of utilizing the service of camels therefor was promptly adopted by General Lord Wolseley. In the SCIENTIFIC AMERICAN of December 20 we gave an illustration and description of the equipment of this unique cavalry service, without whose aid it would hardly have been possible for the divisions of Gen. Earle and Gen. Stewart to have made their forced marches from Korti across the desert, the former toward Berber and the latter to the Nile near Shendy. In these marches and the subsequent retreat even the endurance of the camel has been severely tried, as it is quite a different thing to take a modern army over the Nubian or the Libyan desert from what it is for an Arab caravan to traverse these dreary wastes. The English soldiers have now become familiar with the characteristics of their uncouth steeds, but it is said that the closer acquaintance has not increased their estimation of his character, and he is declared to be a sulky and troublesome beast, whose use is a most disagreeable necessity.

Rhigolene.—A Local Anæsthetic.

The use of cocaine as a local anæsthetic has directed attention to the value of petroleum naphtha for similar purposes. The name rhigolene was given by Dr. H. J. Bigelow, of Boston, to a light inflammable liquid obtained by the repeated distillation of petroleum. It is probable that it is not a definite chemical compound, but it is said to be one of the most volatile bodies in existence. By using it in the form of a spray with a common atomizer, it produces a degree of cold sufficient to freeze any tissue with which it may come in contact. Dr. W. Chapman Jarvis, of New York, finds that its action is more decided than that of cocaine, although of shorter duration. Skin and mucous membranes may be divided deeply and freely without fear of pain or hæmorrhage. Its effects pass off quickly, so that the operator has to act with promptness. It is a good plan to employ it in conjunction with cocaine. When not in use, it should be kept on ice or in a cool room, tightly corked. In a warm place it would probably burst the bottle or blow out the cork. It has been accused of possessing explosive properties, but probably it is safe if not brought in contact with an open flame. It should not be used for cases which require artificial light. Very little is known about it as yet, although its properties were cursorily investigated some years ago.

Casehardening Axles.

Here, says the *Carriage Monthly*, is a brief description of the process of steel-converting axle spindles. The axles are first forged and then machined or finished in the lathe. The threaded portion is then incased in a ball of fire clay. The axles are next stood (points down) in metal boxes; the space between the axles is then filled with animal carbon, usually calcined "bone dust," to a point one inch or more above the collar. A fire is then made about the metal boxes, and kept up until the carbon ignites and penetrates the iron, the whole being at a red heat. When thoroughly charged with the carbon, and while red hot, the axles are removed and placed in the cooling vat, the water of which is most usually charged with salt, and sometimes with prussiate of potash. When cold, the spindles are straightened and riveted to the boxes, and the spindle and the inside of the box polished.

The Age of the World.

The Rev. L. J. Templin contributes to our excellent contemporary, the *Kansas City Review of Science*, the following interesting paper on the "Age of the World," a theme which has occupied the attention of students, has been a pregnant subject for theologians to discuss, and is of interest to all intelligent persons:

Scarce a generation has passed away since it was the almost universal belief among the common people that the earth, in both its material and form, was only about 6,000 years old. When geology began to teach that the age of the world was to be reckoned by not only thousands and tens of thousands, but by millions of years, it was arraigned as being in opposition to the word of God, being infidel if not atheistic in its tendencies. But now, few if any persons, who have any just claims to be considered intelligent, question the great antiquity of the earth. But only those who have given special attention to the subject are aware of the vast amount of evidence in favor of this view that is presented by the present condition of the rocks composing the solid crust of the earth.

To give even an abstract of all the proofs that exist in favor of this doctrine would require a large volume; much less can it be compressed within the narrow limits of a magazine article. A cursory view of a few representative facts and general principles is all that can be attempted in the present discussion.

There was doubtless a period in the earth's history when its whole mass was in a state of igneous fusion. When it had become sufficiently cooled to permit the existence of water on its surface, currents would be formed, and erosion would begin. The eroded material would be deposited in still water, and form sedimentary rocks. These would be laid down in horizontal, or nearly horizontal, strata. The cooling of the earth would cause contraction, and this would produce subsidence in places and upheavals in others. By these means the strata already laid down would be broken, contorted, and tilted at various angles, leaving the edges exposed. As erosion would go on, new strata would be deposited on the upturned edges of the older strata, but unconformable with them. These co-ordinate processes would go on as long as the vertical oscillations in the crust of the earth should occur. And they have been in operation from those early times when all the water on the earth was probably kept at a boiling temperature till the present, and we find them still in operation, and still producing the same results. In studying the sedimentary rocks, it should be always kept before the mind that they have been formed by the double process spoken of above, and that these have exactly balanced each other, denudation being commensurate with deposition. The amount of this sedimentary matter, in the aggregate, is enormous.

The various formations vary greatly, being thicker in places, thinner in others, and entirely wanting in still others; but taken altogether, they constitute a thickness of about 72,000 feet, or 13½ miles. In considering these rocks in relation to time, the mind should divest itself of all idea of reducing it to any statement in years. But there are numerous facts connected with their formation that indicate an enormous lapse of time. The enormous depth and vast extent of some of these formations, with certain attendant facts and conditions, impress the mind, almost with the force of a demonstration, that the lapse of time during their formation must have been inconceivably great. Let us begin with the Laurentian, the oldest fossil-bearing rock known to exist. These are found to exist over a wide extent of country in both America and Europe. They attain their greatest known development in Canada, where they exist to the thickness of 40,000 feet. Supposing that they were formed by the gradual detrition of older rocks, and the deposition of the debris at the bottom of the ocean, the time required for the accumulation of such vast quantities of rock material must have been very great. This fact seems further evident from the presence in these rocks of certain substances that were accumulated in them during their formation. Interstratified with the rocks, and sometimes existing in pure beds, are found large quantities of graphite. This is doubtless the result of the perfect carbonization of vegetable matter.

The growth of this vegetation would require long lapse of time, after which it would probably pass slowly through the various grades of lignite, brown coal, and anthracite, before reaching the stage of graphite. Another fact that seems to demand the same interpretation in its relation to time is the vast deposits of iron ore during the Laurentian period. It is in the rocks of this period that we find the rich iron beds of Missouri, New Jersey, Lake Superior, and Sweden. This ore is supposed to have accumulated by the leaching of the oxides and carbonates of iron from the rocks, and its precipitation under the influence of decaying vegetation.

Now, if all the vast beds named above have been deposited by this process, it must have consumed almost inconceivable time. The great Iron Mountain of Missouri itself is estimated to contain not less than 600,000,000 tons of iron above the level of the surrounding country. Extensive beds of limestone are also found here; and as these are supposed to be composed of the shells of mollusks and protozoans, the time for them to live and die in quantities sufficient to form such extensive beds of their calcareous remains could scarcely be reckoned in years. Next above these Eozoic rocks are the Silurian, aggregating a thickness of over 25,000 feet, and crowded with fossils, both animal and vegetable. More than 10,000 different species of fossil animals are already known to belong to this system. These are not, as we would naturally expect from the age of the rocks, of simple and primitive forms; but they are of widely differentiated and highly specialized forms. Coming in as they do, suddenly, in such great variety, and on such a high plane of organic life, how to account for their origin on the hypothesis of evolution has been a very difficult problem. In order to surmount the difficulty, believers in this doctrine generally take refuge in the assumption that between the close of the Eozoic age and the beginning of the Silurian age, as represented in the rock of the two systems, there must have been an enormous lapse of time, exceeding in extent all the time required for the formation of the rocks composing both these systems. . . .

We next come to the carboniferous age—age of acrogens, or coal age. Here we find the most indisputable evidence of enormous stretches of time. The foot-prints of time are so indelibly impressed on the rocks of this age that in some places some approximation to a calculation may be made. The thickness of the rocks of this system varies from 9,000 feet to 15,000 feet. The coal measures proper vary between 4,500 and 13,000 feet. We here have the most irrefragable proofs of the frequent oscillation of the earth's crust. The seams of coal, which compose but a small portion of the thickness of these rocks, are interstratified with the various strata of sandstones, shale, and limestone composing this formation.

As coal is the product of vegetation, which must have grown at the surface, it is evident that to form the seams of coal found at various depths would require that each of these various horizons should have been at the surface at the time when the material forming the coal was accumulated. Now, we find in different coal fields a considerable number of these seams separated by intervening strata of rock. Thus in Nova Scotia there are 81; in Wales, 100; in Belgium, 100; in Westphalia, 117. These aggregate, in some cases, as much as 150 feet of coal that would be passed through in sinking a shaft from the surface to the lowest coal seam. It is evident that where these different seams are found, the land has been elevated and depressed at least once for each of the seams found.

There would be a long period when the land surface was above the water; immense forests of vegetation would flourish until a huge layer of it was accumulated, when by some convulsion of the crust of the earth, or by a gentle—perhaps to human eyes it would have been imperceptible—subsidence, it would be depressed below the waves and receive, either from fluviatile or marine sediment, a layer of earthy material, covering the layer of organic matter to a depth of many feet. A reversal of the process by which the land was depressed again elevates the surface above the waters, and again a layer of vegetation would be produced, to be in turn buried as the former was. And thus these alternate elevations and depressions continued till, as we have seen in some cases, a hundred or more beds of vegetable matter have successively grown and been buried. The pressure and heat to which this organic matter was subjected after such burial eliminated the greater portion of the volatile gases, and converted it into coal. The time necessary for the accumulation of all the organic matter contained in all these strata, and in the subsidence and elevation, and for the deposition of the sedimentary materials composing the rocky strata interposed between these coal seams, cannot be estimated—even approximately. But we are sure it must have far exceeded all conceptions of duration that we can form from our knowledge of human history. We have no data on which to base any estimate of the rate of the accumulation of sedimentary matter, except the present rate of sedimentary deposition at the mouths of rivers. The present average amount of sediment carried down by the Mississippi amounts to enough to cover one mile square to a depth of 268 feet annually, or about one cubic mile in twenty years. At this rate it is estimated that it would have required about 1,000,000 years to have carried down and deposited the amount of materials that originally composed the rocks of the coal measures in the coal fields noticed above.

The time occupied in the growth of the vegetation that formed the various beds of coal may be more nearly approximated. If we assume the amount of vegetation growing on one acre at 2,000 pounds, this would give in 100 years 100 tons. This compressed into coal and spread over an acre of ground would give a thickness of one-eighth of an inch of coal in a century, or 10,000 years would be consumed in producing one foot of coal. This would require, to produce 150 feet, as found in some regions, no less than 1,500,000 years. But probably the growth of coal plants, with the very high temperature and heavy atmosphere, laden as it was with carbonic acid that prevailed during the coal age, would produce a much larger growth of vegetation than we have estimated, and the time would be accordingly diminished. But making due allowance for this, there is no question but the time required for the growth of all this vegetable matter, the frequent subsidences and elevations, and the accumulation of the sedimentary matter composing the rocks of this formation must have required hundreds of thousands if not millions of years.

Another remarkable illustration of alternate elevation and depression, or at least of alternate land and water surface, is found in the Amethyst Mountain, in Yellowstone Park. This mountain is made up of alternate layers of sandstone and conglomerates, and the remains of gigantic forest trees. The stumps and trunks of these trees are found embedded in the rock material of the mountain at various altitudes; the stumps five to six feet in diameter, and the trunks sixty feet long. It would seem that a forest of these gigantic trees would flourish for a time—perhaps for centuries—and then be overwhelmed with a flood, bringing down sand, gravel, and broken stones, completely covering the site of the forest. This would become the soil upon which another forest would spring up and grow, only to be buried up as its predecessor was. And this process of alternate growth and burial has gone on till from one to two score of these gigantic forests have flourished and passed away. Since the last one passed away, the mountain has been elevated 3,000 feet above the river. The time required for all these changes must far exceed all our conceptions of duration.

It is an undoubted fact that the topography of the present surface of the earth has been largely affected by erosion. This process is constantly going on, degrading the eminences, changing the declivities, and gradually wearing away the whole surface of the land. The sum of this erosion, since the last great geological changes, is enormous. The erosion over many portions of England is estimated at 10,000 to 11,000 feet.

In the Appalachian region it is proved that the erosion has amounted in some cases to not less than 20,000 feet in depth. In portions of the Rocky Mountain regions this erosion has been still greater. Professor Powell informs us that in the Uintah region the amount of erosion has exceeded five miles in depth in some places, with an average depth of three and a half miles over 2,000 square miles of country. The time necessary for the removal of so large an amount of material would depend on the agencies employed and the energy with which they operated. It would undoubtedly be vast.

Water, aided by frost, is probably the principal agent operating in producing all the erosion that has taken place on the earth. The power of water to "wear away a stone" is witnessed in the wonderful channels they have cut for themselves during the present geological age. The Niagara River has cut a channel about 200 feet deep a distance of seven miles. Mr. Lyell estimates 36,000 years as the time necessary for the accomplishment of the task; but as we know neither the present nor the past rate of progress the river has made, such estimates are perfectly unreliable.

A very noted example of river erosion is exhibited by the Grand Canon of the Colorado River, which is 300 miles long and from 2,000 to 6,000 feet deep. But we have no data from which to estimate the time required for the river to cut its way through this distance of rock. We do not know the present rate of recession, nor do we know but the river simply followed and enlarged a crevasse that had been formed by some convulsion of nature. As all such data are unreliable, all conclusions drawn from them must be fallacious. . . .

Two facts present themselves for consideration here, that go far to vitiate all such estimates. One is the fact that in the earlier ages of the world the higher temperature that prevailed, and the large per cent of alkaline and acid substances held in solution by the water, would greatly increase its erosive power, thus requiring a far shorter time to produce a definite amount of sediment than is required at the present time. This would require a large reduction of the above estimate. But on the other hand, we have the fact that the erosion that is now taking place is principally operating on sedimentary rocks; and doubtless this has been true during a great portion of geologic time. This same material has been laid down and removed again and again, so that an estimate of the time that it would take to deposit the materials of the sedimentary rocks as we know them gives but a very slight clew to the time since the beginning of their deposition. . . .

Different scholars have attempted a calculation of the age of the earth from the rate of cooling of heated bodies exposed to a cold atmosphere. But the various elements entering into the mathematical analysis of this problem are so numerous and uncertain that there is no agreement in the conclusions arrived at. These conclusions vary from 160,000,000 to 600,000,000 of years as the probable time required to bring the earth from a fluid state to its present condition. . . .

From all the foregoing considerations we are led to the conviction that though the earth has existed for an inconceivable length of time, yet from the data at command it is impossible to reduce it, even approximately, to years; that these unmeasured and unmeasurable years are known only to Him who is from everlasting to everlasting, yesterday, to-day, and forever.

ENGINEERING INVENTIONS.

A car brake has been patented by Mr. Charles E. Candee, of New York city. This invention covers a brake mechanism comprising friction drums on the truck axles and metallic elastic bands provided with compression bars and fitted to be clasped upon the drums by a tightener.

A journal bearing for car axles has been patented by Mr. Charles E. Candee, of New York city. The bearings consist of a friction ring and rollers, combined with a box having a central abutment, with other novel features, the object being to distribute the friction and strains over a large extent of surface, so as to save wear, and also to support the journal against side strains.

A railway frog has been patented by Mr. Nathaniel W. Boyd, of Steelton, Pa. This invention consists principally of a frog made up of T-rails, and in the application of key bolts and throat castings for holding the parts of the frog together and in proper position, making an elastic switch frog, which can be placed anywhere upon the cross ties or upon planks, and one which will be cheap and easily adjusted.

A propeller has been patented by Mr. John J. Williams, of Point Pleasant, Mo. This invention is designed as an improvement on endless chain propellers, metal bands being substituted for the chains, with buckets rigidly attached thereto, thus doing away with all working joints, and adding to the durability and efficiency of the propeller, peculiarly constructed braces being combined with the bands to support the buckets in action.

A cylinder lubricator has been patented by Mr. Samuel Townsend, of Detroit, Mich. This invention covers improvements in the oil cup, sight feed tube, and condenser, providing an automatic drop sight feed in which the oil drops through an empty glass tube, making a simple and cheap arrangement, with glass oil cup protected from breakage, and requiring but one valve for its regulation. The same inventor has received another patent for an improvement on lubricators for engine cylinders, the invention consisting in a construction which gives a downward drop sight feed, and in connection therewith a circulation of steam which prevents accumulation of oil in the feed tube, and insures a continuous and uniform flow of oil.

MECHANICAL INVENTIONS.

A reamer has been patented by Mr. George R. Stetson, of New Bedford, Mass. This invention relates to adjustable or expanding reamers for smoothing, straightening, dressing, or enlarging holes in various kinds of work, and its various parts are so made and combined as to make a reamer of superior form and build, whereby increased facilities are afforded for regulating the adjustment of the cutters.

AGRICULTURAL INVENTIONS.

A plow has been patented by Mr. Simeon H. Clauton, of Quitman, Ga. This invention relates to that class of plows wherein the beam and standard are made of iron, and usually in one piece, and covers novel details of construction and arrangement of parts in plows of this description.

A check rowing attachment for corn planters has been patented by Mr. Joseph A. Withrow, of Scranton, Iowa. This invention covers a special construction and arrangement of parts in a mechanism for operating the seed dropping slides of corn planters, so as to operate the slides with certainty at regular intervals, in order that the planting may be done in accurate check row.

A reversible plow has been patented by Mr. Jesse L. Delano, of Northampton, Mass. The essential features of the invention consist in the point made separately from the mould board and hung to swing on a horizontal axis, and a double sided mould board swinging on a vertical axis, so the mould board can be reversed with greater ease than with plows of ordinary construction.

A drill tooth regulator and compressor for seeders has been patented by Mr. Romulus P. Ludwig, of Saumsville, Va. This invention relates to devices used to plow shallow furrows in which to drop seed and to cover and press the earth thereon, and its object is to raise the drill or plow point at will, and mechanically hold it raised while traveling and not in use, and to set it to plow deep or shallow as may be required, for which purposes a special construction and combination of parts is provided.

MISCELLANEOUS INVENTIONS.

A gate has been patented by Mr. Hardey H. Clement, of Hazel Dell, Miss. It is a movable gate with an opening through it, a horizontally-sliding gate mounted on the first gate, and a vertically-sliding gate on the horizontal gate, so that by it passage ways of various sizes can be formed in fences, barns, etc.

A process of extracting gold, silver, and lead from ores has been patented by Mr. William E. Harris, of New York city. This invention consists in mixing finely pulverized ore with the oxides of iron or copper, and then smelting the mixture on a bath of lead.

A surgical needle has been patented by Mr. George Wackerhagen, of Brooklyn, N. Y. This invention covers an improved form of needle for sutures, either interrupted or continuous, which can be used without removal from its holder during an operation, and which covers the thread, so as to carry it through the tissues easily.

A saloon hopper tube for keeping clean saloon hoppers in railroad cars has been patented by Mr. James Martin, of Louisville, Ky. This invention provides a movable tube or lining, made of felt, paper, wood, or other flexible material, and of various forms, but so that it can be removed and replaced at any time with but little trouble and expense.

A printer's quoin has been patented by Mr. William Hendrickson, of Brooklyn, N. Y. It is made with side pieces having inclined dove-tailed side grooves, a wedge having inclined angular end grooves, and a swiveled screw whereby the quoin can be readily expanded and contracted, the side pieces being connected and kept in place upon the wedge by guard screws.

A shutter for photographic cameras has been patented by Mr. Cyrus Prosch, of New York city. This invention consists in a novel manner of applying the spring used to throw the shutter, so the shutter has a gradual action at starting, avoiding jar and preventing damage to the picture; there is also an adjustable spring friction device for varying the working speed of the shutter, to give a shorter or longer exposure of the sensitive plate, means for insuring the perfect exclusion of light when the shutter is closed, and other novel features.

NEW BOOKS AND PUBLICATIONS.

STEAM MAKING, OR BOILER PRACTICE. By Charles A. Smith. The *American Engineer*, Chicago.

This work aims to present in condensed form the best experience in modern boiler practice. Its treatment of the subjects of combustion, firing, design, and construction of boilers, and the table of experiments with boilers, show good judgment and a broad comprehension of this field of investigation.

DIE MEHRFACH-TELEGRAPHIE AUF EINEM DRAHTE. (MULTIPLE TELEGRAPHY ON A SINGLE WIRE.) By A. E. Granfeld. A. Hartleben, Vienna, Pesth, Leipzig.

This work, which is the twenty-fifth volume of Hartleben's Electro Technical Library, is devoted entirely to multiple telegraphy on one wire. The author fully explains the necessity of multiple telegraphy, and describes the different systems. He has made a very careful study of the electric and magnetic functions in electro magnets. In the remaining chapters he has described the different methods and apparatus, which are too numerous to be mentioned here. The author has evidently studied the subject matter of his work with the greatest care, and has taken great pains to avoid all ambiguity, thereby rendering his work of value not only to the professional student, but also to the amateur. The work is provided with eighteen cuts and five tables.

THE CONSTRUCTION AND USE OF Grinding Machines is the title of a well illustrated and plainly written little book just issued by the Brown & Sharpe Manufacturing Company, of Providence, R. I. The firm are well known manufacturers of fine machinery and machine tools; they very naturally consider that it is necessary to understand a machine, and know how to use and take care of it, to obtain the best work therefrom; and in order thus to educate mechanics in regard to their universal grinding machine, they have brought out this book. The firm first designed and constructed grinding machines several years ago to supply a want in their own business, and now consider them almost indispensable in the production of first class work. For the manufacture of standard machinery and tools, the duplicating of parts of small machinery, and for operating on hardened surfaces to insure great accuracy, these machines are not only economical, but by their use a higher average grade of work is performed.

Special.

WHO WAS BRIGHT?

The name of Bright is frequently on the tongues of people who know nothing, or little, of who "Bright" was, or the nature of the peculiar derangement of vital functions with which his name has long been linked. Dr. Bright was a famous British surgeon and anatomist. He made the kidneys and their disorders his special study. He first pointed out the nature of the granular degeneration of the tissues of the kidneys, and showed the demoralization of these organs when in such a condition that their secreting powers are so impaired that the urea is not sufficiently separated from the blood. In the unpleasant condition of the internal economy which is known as "Bright's disease," albumen is carried off with the watery excretions from the bladder. This impoverishes the system almost as greatly as would copious and systematic bleeding, for the albumen is needed in the body, being, in fact, one of the great agents in nutrition. Those who labor under the disadvantage of "Bright's disease" are liable to grievous congestion and inflammation, not only of the kidneys, but of other important organs. Coma, convulsions, and apoplexy may occur as part of the progress of the disease. Thus it will be seen that the malady is not a mere kidney ailment, but one involving the decay of the vital forces of the body.

"Bright's disease" is proverbially hard to cure. Nay, more than that, it is generally pronounced incurable. As soon as the patient begins to show clear evidences of being afflicted with this malady, the doctors give him up and tell him to prepare for death. They can alleviate his sufferings, and do something to temporarily arrest his inevitable decay, but beyond this they give him no hope. An eminent physician in a recent address before the New Jersey Medical Society said: "The modern physician, in his multitudinous drugs, finds few remedies. . . . Medicine finds its highest triumphs in the prevention, not in the cure, of disease. . . . Who cures rheumatism, or typhoid fever, or chronic Bright's disease? . . . and yet, who refrains from prescribing?"

Now we will all agree that prevention is a great deal better than cure. But when we find some fellow-mortal actually in the power of a terrible disease, "Bright's" for instance, it is too late to talk of preventive measures. Something must be done toward cure, if cure be possible. To thousands of anxious men and women the vital question to-day is, "*Can Bright's disease be cured?*" To others, means of prevention may have interest, but to those on whom the disease has its grip the question of cure is a personal matter of life or death. All who are thus concerned will be greatly interested in the experience of a gentleman well known in Philadelphia, who was so severely afflicted with "Bright's disease" that the physicians gave him up. His present condition of heartiness is such as naturally to awaken curiosity as to how his recovery was effected.

Mr. George W. Edwards is a well known Philadelphian, now in middle life. His father was one of the most public-spirited citizens of the Quaker City, who did much to improve the place by the erection of a number of hotels and other edifices of public value and permanent adornment. Mr. Edwards, Sr., died about twenty years ago, of Bright's disease, and so did his wife. The present Mr. Edwards thus inherited the disease from both father and mother, and at an early period of his life was under its power to such an extent that he became a confirmed invalid, with but little hope of recovery.

One of our editorial staff who had himself been threatened with Bright's disease, and was anxious to see a man who had been brought out of it, recently satisfied his curiosity by a visit to Mr. Edwards. On being introduced to that gentleman at his place of business, he thought there must be some mistake in the person, so hearty and robust did Mr. Edwards appear. But Mr. Edwards assured him that he was indeed the man, and gave the account of his experience much as follows:

"Yes, I had Bright's disease. My father and mother died of it; so did two of my brothers. It came on me slowly and gradually. I passed much albumen, and many epithelial casts, which are the surest indications of the ravages of the disease. For three years I was so prostrated as to be unable to attend to business. I was utterly exhausted. Not only was I unable to walk with comfort, but I could scarcely walk at all. I averaged hardly an hour's sleep in twenty-four, and even that little was broken and unsatisfactory. Nearly all the time I suffered with severe neuralgic pain in my head and rheumatic pain in my joints. My digestion was miserable. I was nervous and continually disturbed. At the St. George's Hotel, where I lived, I found it impossible to take my meals at the table, for my nerves were in such a state that the rattling of the knives and forks distressed me and compelled me to leave the dining room. The little I was able to eat was brought to my room. I could take a little meat, but no vegetables; and I can assure you that eating was not a pleasure to me.

"Did I take much medical treatment? Oh, yes, but I cannot say that it did me any apparent good, unless, perhaps, in case of the last physician who attended me. He brought me up to a condition in which there was something in me for the Compound Oxygen to take hold of."

"Compound Oxygen? Did you try that; and what did it do for you?"

"Yes, that was what brought me to where you see me now. It was this way: I was in a very exhausted condition, and my friend, Mr. Hagan, of Front Street, who had been made a new man by it, told me that he thought there would be some chance for me if I would try Compound Oxygen. The prospect did not at first seem very encouraging, yet I thought I would make the trial. So prostrated was I that walking from the St. George Hotel to Starkey & Palen's office, which is not over half a mile, completely used me up, and I had to rest for two hours after making the effort. This was my first attempt at going out. After this, when I went to the office for treatment I took a cab, for the first few visits. But the necessity for the cab did not last a great while. The Compound Oxygen did not begin to do its work suddenly, but what it did it did well. In about ten days the severe pains in my head were greatly relieved, and before many more days they were gone. Then I began to gain in strength. Gradually the rheumatic pains went away, my digestion improved, so that eating was not the torment it had been. I soon became able to enjoy refreshing sleep, and this added to my comfort and gave me new strength.

"For two months I took the Oxygen Treatment at Starkey & Palen's office, daily gaining. When I first began to take it I was so weak that I could not inhale for more than ten or fifteen seconds. By steady practice and with increasing strength I found myself able to inhale for nearly minute at a time. I began in March, 1882, and I finished in May. By this time I was so well that I needed no more treatment."

"Have you ever had occasion to resort to the treatment again?"

"Never but once. Then I thought I felt some indications of a return of my old trouble. The use of the Compound Oxygen for a very short time set me to rights. Now I am able to attend to business regularly and cheerfully. I live in the country and come to town every day. I sleep soundly, take a good deal of active exercise, eat pretty much everything I want, and my digestion is good. What more can I ask for?"

"You are a firm believer in *Compound Oxygen*, then, Mr. Edwards?"

"Most certainly and thoroughly. After what it has done for me I am free to speak well of it, and to recommend it to others as a great vitalizer and restorer."

Such a case as this one is surely calculated to make people think. Thinking is good; acting is better. In such diseases as "Bright's" there is no time to be lost. If you have even the slightest indication of an attack, send to Drs. Starkey & Palen, 1109 Girard Street, Philadelphia, for their treatise on Compound Oxygen, and inform yourself thoroughly as to its nature and action. It will be mailed free.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter,** should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) **H. C. A. writes: I want to make a** 4 cell plunge battery. I have 4 carbon plates 12x6x¼. 1. How large must the zinc plates be? A. The zinc plates should be of the same size as the carbon plates. 2. Will I obtain a stronger current by having 2 carbon plates to each cell? A. The current will be somewhat stronger, and the battery will be more constant. 3. What quantity of bichromate of potash and sulphuric acid should I use to each gallon of water? A. About 4 ounces of bichromate of potash to the pint of water, and one-fifth the bulk of this solution of sulphuric acid.

(2) **J. D. asks how to cut and bore** holes in glassware. A. Make a drill of best steel; harden it as hard as fire and water will make it; keep it very sharp, and moisten it with turpentine.

(3) **C. Z. D. asks: 1. Does a covering of** sleet protect the buds of trees from excessive cold, or, in other words, does it require greater cold to destroy buds upon fruit trees when covered with sleet than when they are uncovered? If so, how much more? A. The sleet does not protect, as snow sometimes does; the ice is nearly always fatal. 2. What form of armature would give the best results for incandescent lighting, in a dynamo twice the size of the one given in SUPPLEMENT, No. 161? How many and of what power would the lights be? A. Siemens' new form or Edison's. Such a machine ought to run two 8 candle power lamps. 3. Where can I find the best form of storage batteries? A. You will find nearly all forms of storage batteries described in the SCIENTIFIC AMERICAN SUPPLEMENT.

(4) **G. A. R. asks the names of such** books as are necessary for one to study to post himself thoroughly in the electrical science. Also a good self-taught algebra and geometry. A. Begin with Ganot's Physics, Sprague on Electricity, and follow up these with such works as Gordon's Electricity and Magnetism, and the Electric Light by the same author. We know of no better books on algebra and geometry than the ordinary text books.

(5) **A. E. C. asks (1) how to mend** broken battery carbons; the fractures all fall within the liquid; the liquid is electropoin fluid. A. We know of no practical way of doing this; as the carbon plates are inexpensive, the broken ones should be replaced by whole ones. 2. How can I make ordinary glue so as to fasten oiled surfaces together, and hold them with the same tenacity as clean ones? A. We do not believe such glue can be made to hold without removing the oil. 3. Is there any method for destroying the warping propensity of wood? A. By rendering it entirely impervious to water, as by saturating it with melted paraffine. 4. Does the potassium bichromate in soluble glue remain so only while light gets at it? A. The glue remains permanently insoluble. 5. I wish to have a cheap varnish for toys; one coat must answer, no filler to be used, and yet that coat to give the bright gloss noticed on cheap German toys. If there is such a varnish as I desire, how can it be colored? A. Common rosin dissolved in turpentine will make such a varnish as you require. You can readily add any of the dry pigments used for paint.

(6) **W. L. P. asks if an electrical cur**rent can be obtained by placing two telegraph instruments at a short distance, say across a small stream, with only ground wire to form circuit. If it can be done, how are the ground wires attached? A. We know of no method of doing this.

(7) **C. F. asks if there is such a sub**stance as "animated marble." A. It is simply a figurative expression for life-like sculpture.

(8) **L. D. C. writes: What size battery** ought I to get to light a room 40x60 feet? A. You cannot economically produce an electric light by means of batteries. You might light your room with 50 cells of Bunsen battery and an arc light.

(9) **T. W. M. asks: What is the ma**terial used in making blacklead crucibles, and is it the same material that is used in making lead pencils? A. The substance is the mineral graphite mixed with clay. It is the same as that used for making lead pencils.

(10) **J. M. C. asks: 1. Of what is the** black varnish or coating now used on cheap grades of silver mirrors composed of? A. The article used is probably the common asphalt varnish. 2. How is it prepared? A. An excellent variety of this varnish can be prepared as follows: Take 8 ounces burnt umber, 4 ounces true asphaltum, and 1 gallon linseed oil. Grind the umber with a little of the oil, add to it the asphaltum, previously dissolved in a small quantity of the oil by heat; mix, add the remainder of the oil, boil, cool, and thin with a sufficient quantity of oil of turpentine.

(11) **G. W. B. desires information as to** how old walnut and mahogany furniture is polished, and also the French method of polishing. A. In order to clean and finish old furniture, it is necessary to scrape and sandpaper the work as smooth as possible; go over every part with a brush dipped in furniture oil, and let it remain all night; have ready the powder of the finest red brick, which tie up in a cotton stocking, and sift equally over the work the next morning, and with a leaden or iron weight in a piece of carpet rub it well the way of the grain, backward and forward, till it has a good gloss. If not sufficient, or if the grain appears at all rough, repeat the process. Be careful not to put too much of the brick dust, as it should not be rubbed dry, but rather as a paste upon the cloth. When the surface is perfectly smooth, clean it off with a rubber of carpet and fine mahogany sawdust. This process will give a good gloss, and make a surface that will improve by wear. The French method of polishing is as follows: With a piece of fine pumice stone and water pass regularly over the work with the grain until the grain is down, then, with powdered tripoli and boiled linseed oil, polish the work to a bright face. This produces a very superior polish, but it requires considerable time.

(12) **H. A. L. desires a recipe for liquid** glue. A. Soften 100 parts best Russian glue in 100 parts warm water, and then add slowly 5½ to 6 parts nitric acid, and finally 6 parts powdered sulphate of lead. The latter is used to impart to it a white color.

(13) **J. E. A. asks for a receipt for mak**ing gold beater's skin tougher than it is when it is bought, so as not to tear so easy when used in making whistles for imitating animals, birds, etc. A. Gold-beater's skin is derived from the cæcum of the ox, which being well cleaned is doubled together, the two mucous surfaces face to face, in which state they unite firmly. The membrane is then treated with solutions of alum, isinglass, white of eggs, etc., and sometimes with creosote, and being beaten between folds of paper to expel the grease, is finally pressed and dried. The leaves thus obtained, each 5½ inches square, are made up into moulds. As the gold beater's skin is therefore somewhat complex in its manufacture, we would recommend its substitution by some other variety of skin, or possibly parchment paper might be found sufficiently tough for the purpose.

(14) **J. H. S. asks (1) how to renovate** old frames (gilt or bronze)? A. Gilt frames may be cleaned by simply washing with a small sponge, wet with urine, hot spirits of wine, or oil of turpentine, not too wet, but sufficiently to take off the dirt and fly marks. They should not be afterward wiped, but left to dry of themselves. To regild frames it is necessary to take a sponge and some clean water and wash the frame well, then let it dry, procure some gold size, make some thin size from dry hide or parchment, mix enough warm with the gold size to enable you to work it in the frame with a camel's hair brush, give it two coats, when dry rub it over with a piece of fine sand paper; it will then be ready for gilding. When the frame is covered, rest it on its edge to drain; when perfectly dry, dip a pencil into water, and wipe the gold over with it; it will take the particles of gold off and make it appear solid. For any parts not covered, take bits of leaf with a dry pencil, and lay on as before, then give the whole a coat of clear parchment size, brush the back edges over with ocher, and the frame is then ready. 2. Also, how to lacquer polished brass without heating it? A. Use 2 ounces gum sandarac and ½ ounce gum mastic dissolved in one pint of alcohol. When completely dissolved, add 5 drops glycerine.

(15) **H. W. G. asks if there is such a** word as "oxiden," and if there is, what does it mean? A. There is no such word in the English language. It is the plural in the German for "oxides."

(16) **W. S. asks: What other substance** is better than plaster of Paris for moulds, that is, something harder, for it is impossible for me to take more than one or two good sharp runs before it is dull or crumbles? A. Sulphur is sometimes used. Saturate the plaster mould with boiled linseed oil and let it dry. Possibly you will have to resort to type metal, which is largely used for moulds.

(17) **E. H. P. asks how large an engine** would it take to churn 4 gallons of milk with say 40 or 50 pounds pressure? A boy ten years old works the churn. Could I make a gas pipe boiler for such an engine? If so, what size pipe, number of feet, and construction? A. Cylinder 1 inch diameter, 2 inch stroke; 6 feet 1 inch gas pipe in a coil will be sufficient for a boiler.

(18) **J. P. C. asks: 1. What amount of** power can be had from a six foot turbine fed by a three inch pipe falling 150 feet? A. You give the height and diameter only, but should send the length of the pipe also, and the exact form of turbine. The value of your discharge may be from 25 horse power for vertical pipes to anything less, according to length of pipe. 2. What is the rule to find horse power from different size of pipe, fall, and turbine? A. The formulas for power from the flow of pipes under pressure are rather complex, when considered under the different conditions found in practice. From the formula in "Haswell,"

$$2{,}356\sqrt{\frac{h}{l}\times d^5} = \text{volume in cubic ft.}$$

per minute—where h is height, l is length of pipe, and d^5 is the 5th power of the diameter of the pipe in feet or decimal parts of a foot. For the initial power of the discharge, $62{\cdot}5 \times V \times h$ = power of the discharge—where the flow pipe is large and the nozzle small enough to disregard the friction; or, in other words, the discharge from the turbine is so small as not to effect the pressure due to height. For the coefficient of an open pipe of equal bore throughout:

$$\left(0{\cdot}0144 + \frac{0{\cdot}01746}{\sqrt{V}}\right) = \text{coefficient};\ V =$$

velocity of flow. Then $62{\cdot}5 \times V \times h \times C$ = power. For the effect through turbine, you may expect from 75 to 85 per cent effective work.

(19) **G. W. L. asks how to bleach horns** so as to make them nearly transparent. What I wish them for is to finish and mount for ornaments. A. Besides hydrogen peroxide, the method of using which is fully described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 339, you can bleach the horns by immersing for a short time in water slightly mixed with sulphuric acid, chloride of lime, or chlorine, or they may be exposed in the moist state to the fumes of burning sulphur, largely diluted with air.

(20) **J. X. D. asks how the colors on a** sample of goods sent are made and applied to different kinds of cloth. A. The colors are various shades of the aniline colors. They are applied to the fabric, which is probably mordanted, by means of so-called block printing. Each shade has a different block, and the various gradations of tint are brought about by one or more applications of the block.

(21) **E. A. S. asks how to dye cotton** yarn black with aniline, so the color will be fast; also which is the best to use in dyeing with aniline, the powder or the liquid. A. The wool is first dipped into a solution of aniline salt (aniline hydrochlorate), then plunged into a bath of potassium chlorate containing one per cent of copper sulphate. The fabric is then removed from the bath, dried in a warm room, and washed with soap. During the drying process the color is developed. Aniline black of itself is insoluble, and is formed in the fabric during the process of development.

(22) **D. S. M. Co. asks for a recipe for a** white stamping powder suitable for dark goods? A. By mixing white lead to the consistence of paint with a rather thin mucilage of acacia, we think a satisfactory white marking ink can be made. A more successful process is by dusting over the stencil the white lead mixed in powder with a little resin, fixing the pattern by covering with a piece of paper and ironing with a hot iron. When the cloth can be turned (as between boards or book covers) without scattering the powder, it may be preferable to apply the heat directly to the back of the fabric.

(23) **T. H. asks for a recipe for remov**ing stains from a marble hearth, caused by burning of note or letter paper (I suppose sized) on the same. A. Take 2 parts of common soda, 1 part of pumice stone, and 1 part of finely powdered chalk; sift it through a fine sieve, and mix it with water; then rub it well all over the marble, and the stains will be removed; then wash the marble all over with soap and water, and it will be as clean as it was at first.

(24) **P. D. wishes a receipt for a trans**parent lacquer for covering a highly polished brass, which does not deaden the finish, and will keep it from tarnishing, such as the eastern chandelier manufacturers use. A. Dissolve 2 ounces gum sandarac, and half an ounce gum mastic in one pint alcohol. When dissolved add 5 drops glycerine.

(25) **C. E. M. wishes a receipt for mak**ing a cement which will fasten glass and white metal together. A. The following are receipts for cap cements: 1. Resin, 5 lb.; beeswax and dried Venetian red, of each, 1 lb.; melted together. 2. Equal parts of red lead and white lead, sometimes a mixture of white lead and glycerine, is used.

(26) **J. T. W.—Bromine has a specific** gravity of 3·1872; iodide of methylene, 3·342; and mercury, 13·55.

(27) **C. H. J.—An alloy consisting of 4** volumes of cadmium with 5 volumes each tin, lead, and bismuth is quite liquid at 150° F. The alloy given by you is known as Wood's patent fusible alloy, and melts between 150° and 160° F. We are not familiar with the composition used on the fire extinguishers, and hence cannot say as to their melting point. Nor do we know of any alloy that is liquid at 120° F. An amalgam is an alloy containing mercury.

(28) **P. D. asks: 1. What is the chemi**cal formula of protoplasm, of grape sugar, and of linseed oil? A. The chemical composition of protoplasm cannot be satisfactorily expressed by a formula. Grape sugar has the formula $C_6H_{12}O_6$. Linseed oil has approximately the formula $C_{16}H_{28}O_2$. 2. The specific gravity of lithium, cobalt, and manganese? A. The specific gravity of cobalt is 8·9: of lithium, 0·6; of manganese, 8.

(29) **W. L. E. asks: Is there any method** of depriving crude petroleum of its disagreeable odor? A. Twenty pounds of petroleum are placed in a suitable vessel, and by means of a long necked funnel two ounces each of concentrated sulphuric acid and nitric acid are poured into the receptacle; finally 1 pound of alcohol is carefully poured on top of the oil. The latter gradually sinks to the bottom. As soon as it comes in contact with the acids it develops heat and causes slight effervescence from boiling. A small quantity of nitric ether is formed. This and similar products of the reaction produce an agreeable odor which is imparted to the petroleum. The latter assumes a yellowish color, and, after having stood in contact with the acids and alcohol for about one hour, is gently agitated with water, and after about 10 hours decanted. The lower layer may be used for deodorizing the heavier petroleum oils by agitating them for twenty minutes with the mixture, decanting after twelve hours, and then washing with milk of lime to remove all traces of acid.

(30) **A. L. K. writes: I see in my SCIEN**TIFIC AMERICAN, vol. lii. and No. 1, a list of nineteen fine metals, whose value respectively is above $1,000 per pound. Has not one been overlooked, viz., indium? I notice zirconium quoted at $7,200 per pound. What is the metal itself used for? How are its oxides, chlorides, etc., etc., manufactured? And for what purpose used? Where bought and sold, and at what prices, etc.? A. Indium is an exceedingly rare metal. According to a table prepared by Dr. Bolton and published in 1875, the price of indium per pound was $1,522.08, this being at the rate of $3.36 per gramme. In 1880 it was quoted at $4.83 per gramme. Zirconium has no practical applications, unless it be in connection with the electric light. The various salts are prepared by chemical means from the silicate or mineral zircons. It is only bought and sold as a chemical curiosity at fancy prices, from dealers in pure chemicals and chemical apparatus.

(31) **E. W.—The Martini-Henry rifles** used in the British army are made at the Government works, Enfield, near London. They combine the Martini breech action with the Henry barrel.

(32) **M. H. C.—Certain of the lower** forms of life are capable of existing and even growing in ice without having their vitality destroyed.

(33) **J. M. L. writes: I have a Laurent** polariscope out of which I am unable to get good results because the alcohol sodium flame is not bright enough. Even with the clearest sugar solution the shadow is very dark and the line unsensitive. Can I do anything to increase the brilliance of the light without destroying the monochromatic character of the flame? Gas, which might be better, I cannot obtain. A. Use a lamp burning coal oil.

(34) **J. P. G.—1. In reference to gelatine** sensitive paper you can obtain an improved kind from Messrs. E. & H. T. Anthony & Co., 591 Broadway, N. Y., which is thin and has a toothed surface for taking a crayon or pencil, well adapted for enlargements. The pure whites are obtained by thorough fixing, and, after a careful washing, by running the paper through very dilute solution of water and sulphuric acid:

Water	80 oz.
Sulphuric acid	1 oz.

The bluish prints you speak of are made on paper sensitized on a nitrate of silver bath; the paper is then dried, and put in a solar camera and exposed to the sun. The paper is not like that used in the blue process of copying drawings. The solar camera is an expensive, cumbersome apparatus, and requires special skill to operate it. It is not possible to make solar prints with the apparatus described on page 86, vol. l., of the SCIENTIFIC AMERICAN, as the ordinary silver paper is too insensitive. 2. The focus of your marine glass is too short for an astronomical telescope.

(35) **W. S. asks: Is there any fluid other** than water that can be converted into a gas, as water is into steam, that will assume its natural order, as does steam into water? A. The common hydrocarbons, which are volatile at ordinary temperatures, form gases without decomposition, such as, for instance, alcohol, ether, or chloroform.

(36) **E. F. S. asks how large chunks of** coal are made into ornaments, such as match safes and inkstands—what tools are used to cut it, and how it is polished. A. There are no special tools used, and, the polishing process is similar to that adopted with any mineral. They can be polished by rubbing with sandpaper of a coarse character, and finally finishing with a finer paper or a little chalk.

(37) **C. R. F. asks for a good receipt** for tinning malleable iron. Also a receipt for making a good gold solution. A. For tinning malleable iron: Clean the work of grease or oil by boiling in caustic soda water, then rinse in clean hot water. Then thoroughly clean from scale in a bath of muriatic acid one part, water four parts. Then dip in a solution of muriate of zinc and sal ammoniac, made by saturating muriatic acid with metallic zinc and adding ten per cent by weight of sal ammoniac. Then dry on a hot plate or otherwise, and dip in the melted tin bath. Gold solution: Dissolve fine gold in a mixture of two parts hydrochloric acid, one part nitric acid, to saturation. Gently heat the mixture over a sand bath until the acid is evaporated, leaving a dark red mass, which is soluble in distilled water, with which you may make the solution of the required strength. Also see SCIENTIFIC AMERICAN SUPPLEMENT, No. 160, on electro gilding and the solution.

(38) **W. W.—There is no way of hard**ening brass that has been annealed, except by compression. Such a process would be worth millions.

(39) **E. N. N.—The difference shown** by the almanac represents the equation of time, or difference between the mean or clock time and the solar or sun time, the solar time not being an equable division during the year, caused by the nodes not corresponding with either axis of the earth's orbit. The length of the solar day varies with the latitude, and the mean clock indications should correspond.

(40) **W. McP., Jr., asks: What will make** white paper transparent, so that when a bright color is placed on the back it will show through distinctly? A. Dissolve a piece of white beeswax, about the size of a walnut, in half a pint spirits of turpentine; then having procured some very fine white woven tissue paper, lay it on a clean board, and with a soft brush dipped in this liquid go over one side and then turn it over and apply it to the other; hang it up in a place free from dust to dry. It will be ready for use in a few days. Some add a quantity of resin, or use resin instead of wax. Perhaps simply brushing sheets of paper over with boiled oil will prove satisfactory for your purposes.

(41) **G. C. W. asks for the best way to** prepare a tin churn for churning, so as to keep the milk and butter from sticking to the churn. A. The addition of a little water as the operation proceeds will doubtless help you. A certain amount of experience is also essential.

(42) **J. A. F. asks for a receipt for a** good paste that will not draw engravings when pasted down on paper. A. For this purpose we would recommend the use of a thin paste. A mixture of gum tragacanth and gum arabic forms with water a thinner mucilage than either of these two gums alone. Rice flour is said to make an excellent paste for fine paper work. A solution of 2½ ounces gum arabic in 2 quarts of warm water is thickened to a paste with wheat flour; to this is added a solution of alum and sugar of lead 1½ ounces each in water; the mixture is heated and stirred about to boil, and is then cooled. It may be thinned with a gum solution.

(43) **F. W. G.—A boiler for a one horse** power engine should have eighteen square feet heating surface for effective power. A common cooking stove will not be suitable for such a boiler.

(44) **B. G. M.—Large window plates** may bulge from compression in their setting or by contraction from extreme cold. If the plates are thin, it is possible that their own weight may contribute to the excessive bulge at the bottom. If the putty or whatever holds the glass in place is bulged as you have sketched, it indicates edge thrust, which may be relieved by resetting or cutting away the bearing at the proper place.

(45) **H. O. T.—All vessels propelled by** steam are required to have a United States license; by a recent order, launches and yachts of 5 tons and under only require a fee of $5.00 for the license.

(46) **J. J. B.—We know of no surface** indications for coal save the strictly geological character of the rocks associated with coal bearing strata. See

SCIENTIFIC AMERICAN SUPPLEMENT, No. 241, for geology of the coal region of Pennsylvania, also No. 173, geology of coal; also an interesting article by Prof. Newberry, in No. 383; also Dana's Geology. The humming of a locomotive is caused by the vibration of the spring safety valve, which produces a synchronous resonance of both air and earth through the medium of the escaping steam.

(47) **N. asks: 1. Would an ordinary** Babcock fire extinguisher, 10 x 24 in., with a guarantee of a 220 pound water test, be safe for a steam pressure of say 100 pounds? It is brazed, not riveted. How as to its capacity to supply a cylinder of say 1⅛ x 1⅛ in. by casing it in a fire box for ⅝ its surface? A. The extinguisher is large enough for the engine as stated. We would not recommend you to risk more than 50 pounds pressure. 2. Is there a flexible tubing is the market, rubber or otherwise, that would be suitable for steam at 75 to 100 pounds pressure, say ¼ in. inside? A. The flexible tubing or "steam hose" is made by large rubber houses for this use.

(48) **P. C. asks: The safe transmitting** horse power of a 14 in. double leather belt. Pulley on engine crank shaft, 5 ft. diameter; 80 revolutions; pulley on main shaft, 3 ft. diameter; distance between centers of crank shaft and main shaft, 25 ft. Elevation of main shaft above crank shaft, 15 ft. Sag or droop of belt on top line of belt; also the rule of size for belt for given horse power. A. Your belt will transmit from 18 to 20 horse power. The size of belt for given horse power is very variable, according to strain, speed, and size of pulleys, and also the lap on the pulleys. You will find interesting articles and tables of belts and their power in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 39, 331, and 236.

(49) **G. W. S. writes: I have an engine,** the cylinder of which is 3 in. diameter, having a stroke of 5 in., and running at from 250 to 300 revolutions per minute, which I wish to furnish with steam by pumping hot water into a coil of copper tubing after it has been heated. How much tubing would be required, and what size would be best? I wish to take up as little room as possible. With such a coil for a boiler are water gauges, steam gauges, or safety valves required? A. With 50 pounds pressure your engine will develop about 2⅛ horse power, and will require about 35 square feet of heating surface in the boiler. If made of 1¼ copper tubing outside diameter, you will require 100 ft. in length. For a serviceable boiler, this amount of pipe should be made into several coils terminating in headers at top and bottom, with an outside connection for water gauge, gauge cocks, and safety valve. We do not recommend this form of boiler to the inexperienced.

(50) **W. J., Jr., writes: I am very anxious** to learn to play the violin, but there is no teacher here that I know of. Could such music be taught by mail? And if so, will you give the address of some one that teaches it? A. It is doubtful whether playing on the violin can be taught by mail. However, if you correspond with either the New York Conservatory of Music or else the College of Music, full information will be given you.

(51) **Reader.—The finest wool is said to** be that from Silesia, a province of the German Empire near Austria. The wool obtained from the Angora *goat*, not *sheep*, is the whitest wool known, but we do not think that it equals that obtained from the Australian merino sheep in fineness. See the article on Wool in Appleton's American Encyclopedia.

(52) **J. Z.—Powdered charcoal is the** best filling for a refrigerator, as its antiseptic properties are very essential. Mineral wool is also good, and better if mixed with charcoal. Ashes are too dense, and will not prevent mustiness.

(53) **J. D. W.—Iron is strongest at** about 500° temperature. A boiler is probably a little stronger with 200 pounds steam pressure than with 200 pounds water pressure.

(54) **H. S. B. asks the reason for so many** oil paintings cracking—often those by the best artists, who, it is to be supposed, would use only the best materials. A. The cracking of paints is due to the oxidation of the oils, etc., with which the paints are mixed, causing the canvas to shrink and ultimately to crack. The only remedy is varnishing, which must be performed from time to time by those who desire to preserve their pictures.

(55) **W. F. W.—An analysis of French** bottle glass gave the following results: Silica 53·55, potash 5·48, lime 29·22, alumina 6·01, oxide of iron 5·74, parts in 100.

(56) **C. E. M. asks: Can you tell us what** will toughen stearine? It is too brittle for small candles. Beeswax we have tried, and it will not work. A. Paraffine is used to stiffen candles.

(57) **A Subscriber asks a reliable recipe** for canning asparagus in self-sealing glass jars. A. The asparagus is generally cooked in the jars, and then sealed when deemed sufficiently cooked. The manipulation is one that can only be acquired by experience, and it is therefore impossible to give you any receipt, by following which successful results will ensue.

(58) **C. P. M., Jr., asks how many mints** there are, and where, in the United States. A. Under the coinage act of 1873, the following mints and assay offices are in operation: The mints of Philadelphia, Pa., San Francisco, Cal., Carson City, Nev., and Denver, Col.; and the assay offices of New York, N. Y., Charlotte, N. C., and Boise City, Idaho.

(59) **C. F. M. asks how to make a silent** gunpowder, to shoot birds for stuffing. A. We do not know of any silent gunpowder. A light charge with small shot or else an air gun can be used to kill birds so as not to injure their skins.

(60) **C. F.—To enlarge a card photo with**out a camera for photo crayon work, first soak the photograph in warm water until the albumen paper separates from the card mount. Now dry the albumen print and lay it in a printing frame, picture side up, and then put in on top, film side down, an ordinary gelatine dry plate. This should be done by a red light. Make the exposure to white light for one or two seconds, and develop the image in the ordinary way. When fixed, you have a clear negative of the card photograph. By placing the negative in an enlarging apparatus, as described in the SCIENTIFIC AMERICAN of February 9, 1884, and using sensitive gelatine silver paper, any size enlarged image can be obtained. A positive may be made from the glass negative by contact, and enlarged up by means of a camera. Sketches can be easily made while it is thrown up.

(61) **M. C. G.—To make photo develop**ing trays water tight, whether made of wood or metal, coat them three or four times, after each application is dry, with a diluted solution of Syrian asphaltum dissolved in oil of turpentine. Pasteboard used for the same purpose should first be coated with linseed oil varnish.

(62) **H. K.—There is no better way to** put a high gloss upon the canvas enlargement than by the method of wax and turpentine; we think the proportions you have used were too strong; instead of equal parts of wax and turpentine, try the following formula:

White wax in shreds ....1 oz.
Oil of turpentine. .... 5 oz.

On page 626, October 3, 1884, issue of the *Photographic News*, you will find useful information on this subject. The usual sizing given to cotton cloth is imparted to the thread before it is woven; the glaze is made by passing the cloth through heated calender rolls under pressure.

(63) **I. A. W. asks how to prepare a** a rapid photo printing paper which shall exceed in rapidity the ordinary blue process, and be capable of being affected by light passing through an ordinary 3 ply sheet of Bristol board. A. By means of gelatino-bromide of silver emulsions, rapid printing paper can be successfully made, but its manufacture is attended with considerable bother; and as it will keep well, it is advisable for the beginner to purchase it ready prepared from dealers in photographic materials. One method of preparing the paper is, first, to make a sensitive emulsion as given by Henderson on page 293 of the November 8, 1884, issue of the SCIENTIFIC AMERICAN, and then to coat a sheet of plain Saxe paper with it, by laying the moistened sheet upon a level plate of glass, and bending the edges up by strips of wood, to form a paper dish. The emulsion while warm is now poured on the center of the sheet until a pool is formed large enough to permit it to be spread equally over the sheet by a glass rod. It is then allowed to cool, and when sufficiently set the sheet of paper is hung up to dry. It may now be exposed, film side away from the face of the thick card board drawing, in an ordinary printing frame for two or three seconds to diffused daylight, or for a minute and a half to the light from a large kerosene lamp. The image is then developed by immersing the exposed sheet in a solution of ferrous oxalate of potash composed of saturated solution of neutral oxalate potash acidified with a solution of oxalic acid sufficient to turn blue litmus paper red, 6 ounces, saturated solution of sulphate of iron, 1 ounce. The iron must be poured into the oxalate. Half a dozen exposed sheets may be developed one after the other, in the same solution. The sheet is next washed by soaking in a pan of water for four or five minutes, removed, and immersed in a solution of

Hyposulphite soda.............................1 oz.
Water..6 oz.

for eight minutes, which fixes the print; the latter must now be washed for two or three hours in several changes of cold water, when it may be hung up to dry, which it must do spontaneously, as the application of heat will melt the gelatine film. Examination of the print will show the lines and figures non-reversed as in the original drawing, because the sensitive sheet was laid on film side away from the drawing. The operation of preparing and developing the paper must be carried on in a dark room lighted only by a deep ruby red non-actinic lamp.

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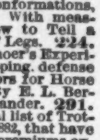

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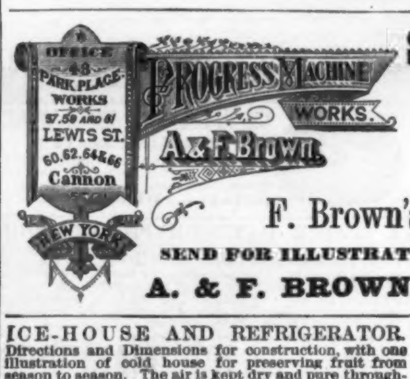

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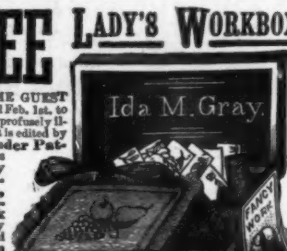

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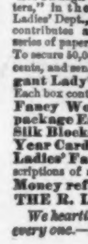

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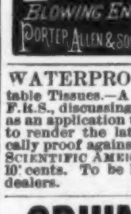

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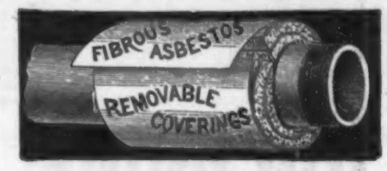

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